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ABSTRACT

During a time when the values in society are changing, knowledge is rapidly expanding, technology is changing, and the use of science and technology is increasing, there is a need to review the role and nature of a biology program for the schools. Such a review was conducted by the K-12 Science Working Party of the Manitoba Department of Education. As a result of that review, this document was produced to provide an up-to-date biology curriculum for Manitoba schools. It is based on 60-70% core topics and objectives and the remainder from a variety of optional biology topics. Included in this curriculum guide are a program overview, program goals, adoption procedures and program implementation, and the curriculum outlines and design charts for biology 200 (general biology) and biology 300 (advanced biology). Each chart includes specific objectives for each biology topic, suggested activities, and references. This curriculum guide also discusses time allotments, safety, evaluation, controversial issues, process skills, students with special needs, and women in science. Appendices include a 12-item, annotated bibliography, and a list of science process skills. (CW)

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biology 200, 300

interim guide

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Manitoba Education

biology 200, 300

interim guide

THIS GUIDE IS SUBJECT TO REVISION ON THE BASIS OF INFORMATION RECEIVED FROM TEACHERS WHOSE USE OF IT IS EXPECTED TO BEGIN DURING THE INTERIM PERIOD. THE INTERIM PERIOD BEGINS SEPTEMBER 1985 AND WILL END JUNE 1988. TEACHERS ARE ENCOURAGED TO MAKE RECOMMENDATIONS OF CHANGES TO THE DIRECTOR, CURRICULUM DEVELOPMENT AND IMPLEMENTATION BRANCH, MANITOBA EDUCATION. MODIFICATIONS ARE NOT EXPECTED TO BE MADE IN THE DESIGN OF THE PROGRAM, HOWEVER, BUT, RATHER, IN SUCH AREAS AS STRATEGIES, RESOURCES AND IMPLEMENTATION.

manitoba education 1985

ISBN 0-7711-0242-9

This interim document was prepared by the Department of Education to meet the needs of students in Manitoba. The pilot guide was tested in Manitoba schools from 1983 to 1985 and has been revised on the basis of feedback obtained from teachers and students. Biology 200, 300 becomes the approved provincial guide effective September, 1986.

The course has been designed to articulate with previous sciences, and to provide concepts, processes and skills which will enable students to relate biology to practical applications in everyday life.

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program overview

PROGRAM OVERVIEW

INTRODUCTION

> The over-arching mood for a new approach to biology teaching is the belief that biological knowledge should be taught for the benefit it brings to the quality of life and to human welfare, and not exclusively for the ennoblement and satisfaction of the researcher. This would mean a focus on the study of the human species as a part of nature, recognizing there is a universal human need to be in touch with nature, our own nature and all of nature.[1]

During a time of changing values within society, rapidly expanding knowledge, changing technology and an increasing use of science and technology, there is a need to review the role and nature of a biology program in schools. In order to accomplish this review, the K-12 Science Working Party conducted a general survey of biology teachers, discussed the relationships between high school biology and post-secondary programs with representatives of post-secondary institutions, and reviewed information concerning potential future developments in high school biology programs. As a result of the review, the K-12 Science Working Party made the following recommendations to the Biology Committee: a) that a "core" set of topics and objectives be developed which represent about 60-70% of the total time available for Biology 200-300; b) that a second set of optional topics which varied from a discipline to a science-societal orientation should be identified.

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[1] Paul DeHart Hurd, "The Teaching of Biology: A Possible Future," BSCS Journal, vol. 1, no. 4 (November 1978), p. 25.

RATIONALE

The goals of a biology program can be derived from a definition of the needs of the individual student and of the society in which he/she exists. Although the needs of the individual and of society as related to biology programs are not necessarily mutually exclusive, they will be considered separately in this guide.

NEEDS OF SOCIETY

In order to maintain a society whose citizens participate in the decision-making process of that society, it is essential that the citizens be informed. Each new advance in technology can place an additional stress on the earth's life-support systems. It is important to learn about the effect of these advances on the life-support systems of the earth so that we can made informed predictions and decisions about the future of our world.

Accordingly, goals for the teaching of high school biology should include a sufficient knowledge of biological processes so that students can:

1. make decisions about the biological effects of radiation, pesticides, foods and nutrition, and other large-scale human activities which affect human life;
2. assess the effects of social interventions such as genetic screening and counselling programs and large-scale medical programs;
3. apply decision-making skills to biological-societal questions.

NEEDS OF THE INDIVIDUAL

To function effectively in a society which is affected by science and technology requires that the individual be able to apply biological knowledge and skills to questions which affect him- or herself. The goals of a biology program as it pertains to the individual include the following:

1. Functional knowledge of biology.
   - The student should be able to apply biological concepts in making decisions about such personal questions as nutrition and the use of tobacco.
   - The student should be able to use basic psychomotor skills required in the study of biology.
2. Knowledge of and preparation for careers in biology.
3. Literacy in biology.
   - The student should be aware of the nature, limitations and accomplishments of science and technology.

PSYCHOLOGICAL BASIS FOR PROGRAM DESIGN

The Biology 200-300 Program design attempts to relate what is presently known about the intellectual development of secondary students to biology and biological education. The nature of the relationship is partially defined by the following statements:

> Various studies indicate that from 25% to 75% of high school and college students do not successfully use such components of formal reasoning as (1) using proportions, (2) making quantitative correlations, (3) making all possible combinations, and (4) controlling variables, etc.[2]

and

> Many students use concrete reasoning patterns, yet that subject matter often requires formal thought. Unless science courses are to become highly selective and admit only students that use formal reasoning patterns with ease, the formation of reasoning patterns should be made an important course objective.[3]

In addition, depending upon the background knowledge of the individual, he/she may begin to operate in a concept at a concrete level and another at a formal level. This is suggested by the following statement:

> Everyone reverts to concrete operational thought whenever they encounter a new area. Before one can reason with hypotheses and deductions based on experience, there must be a sound descriptive base which has been put in order.[4]

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[2] R. Good et al., "Piaget's Work and Chemical Education," Journal of Chemical Education, vol. 56, no. 7 (1979), p. 428.

[3] Robert Karplus, "Science Teaching and the Development of Reasoning," Journal of Research in Science Teaching, vol. 14, no. 2 (1977), p. 173.

[4] J.D. Herron, "Piaget in the Classroom," Journal of Chemical Education, vol. 55, no. 3 (1978), p. 169.

If we accept current research as valid, then we must also acknowledge certain dilemmas and consider them in designing a biology program. We must consider, for example, the difficulty of applying risk and uncertainty to the study of genetics to humans or the uncertainties involved in making decisions about our environment. Also, we must understand that, because of the diversity of students, there is a tendency to teach abstract concepts by providing rules or algorithms. Although the use of algorithms or rules may be satisfactory as a starting point in solving type problems, a more general ability is required. The biology program should promote the development of formal thought processes by teaching students to manipulate, apply and make decisions about information. The development of this ability requires time and patience.

Implications of acceptance of the above ideas about student learning, for program design, are:

- the design indicates, within the objectives, both concrete structures and formal patterns within the development of concepts;
- the design encourages students to compare conflicting data and ideas, generate questions and solve problems that include both relevant and irrelevant data;
- the total number of topics and concepts treated within the "core" program should be reduced in order to develop and apply a concept in a variety of situations; this should extend the range of understandings of the concept and the development of formal thinking;
- some topics which are developed at a more abstract level but do not fundamentally affect student's understanding of ideas should be delayed; for example, some aspects of cell structure and function such as DNA/RNA synthesis were postponed to grade 12 when heredity and bioenergetics were to be developed in the course.

GOALS FOR THE BIOLOGY 200, 300 PROGRAM

The science of biology rests on observation. The principles or laws of biology represent the summary of observed phenomena and their logical interrelationships. These interrelationships, presented in the form of concepts, when applied in technologies, have produced advances which have significantly affected society. It is essential that young people be exposed to the principles and applications of biology during their high school careers. The objectives of the biology program are:

1. To increase students' knowledge of basic concepts in such selected topics as genetics and human systems so that they will be able to:
   - interpret and evaluate fundamental ideas;
   - relate scientific concepts to everyday life;
   - make informed choices about future studies or careers.

*2. To enable students to develop and apply the skills of science. These skills include:
   - science process skills;
   - interpretative and computational skills based on collected data;
   - communication skills related to the gathering and interpretation of information;
   - those psychomotor skills which are required for personal investigations.

3. To develop students' interest in and appreciation of scientific values and problem solving and to promote

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* These skills are more fully defined in Appendix B on page 275 of this guide. Attached to the definition of science skills is a definition of discussion skills which include process, investigative and other related skills.

attitudes such as curiosity and open-mindedness, respect for accuracy, precision, the tentativeness of evidence and the principle of causality.[5]

4. To promote an understanding of the relationship between biology, technology and their effect upon the individual and society in order to help students to:
   . recognize that science and technology are interdependent:
      - science is dependent upon technology for tools, techniques and the formulation of basic ideas;
      - technology is dependent upon basic science for the development of new knowledge and explanations.
   . recognize the human tendencies to reject theories and research findings that conflict with tradition or accepted practices.
      - recognize that scientific activities and results are regulated by a set of values. These values include:
         a) longing to know and understand
         b) questioning of all things
         c) searching for data and their meaning
         d) demanding verification
         e) respecting logic
         f) considering premises
         g) considering consequences.[6]
   . recognize that, in some cases, values of science may be in conflict with values from other "ways of knowing and understanding."
   . describe the difficulty of preventing unforeseen side effects which result from efforts to control imperfectly understood natural processes.
   . describe the interdependence of human material comfort and environmental effects.
   . explain the role of science and technology in increasing human material comfort.
   . examine alternative solutions to science-technological problems.
      - understand the limits of scientific knowledge relative to solution of present problems;
      - recognize the trade-offs, both technological and economic, which are necessary to solve problems;
      - develop a concern and understanding on the part of the student about the responsibility of public and industry to ensure that future generations will be able to enjoy the same quality of life of the present generation.
   . develop decision-making skills to solve problems.
      - identify the significant elements and implications of an issue;
      - distinguish among facts, opinions, beliefs, conclusions and value judgements;
      - identify logical relationships among the elements of an issue;
      - collect, organize, evaluate and present information about an issue.

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[5] Based on: Education and the Spirit of Science, Educational Policies Commission, National Education Association (1966); and David Hawkins, "Education and the Spirit of Science: Critique of a Statement," The Science Teacher (September 1966), pp. 18-20.

[6] M.A. Nay and R.K. Crocker, "Science Teaching and the Affective Attributes of Scientists," Science Education 54 (1970), pp. 59-67. Goal three and this portion of goal four are similar.

OBJECTIVES FOR BIOLOGY 200

CORE UNITS

Unit 1: Cell Structure and Function

The student should be able to:

1.0 Identify the parts and function of a compound microscope.
1.1 Demonstrate correct use of a compound microscope.
1.2 Compare the capabilities of the light and electron microscope.
1.3 Describe how advancing technology has contributed to the development of the understanding of cell structures and function.

2.0 Identify the following cell organelles using a light microscope and describe their function:

- nucleoli
- chromosomes
- vacuoles
- chloroplasts
- cell walls
- cell membrane

2.1 Identify the structures as they appear in an electron micrograph and describe their function:

- ER mitochondria
- pinocytic infolding
- lysosomes
- centriole
- Golgi body
- endoplastic reticulum

2.2 Contrast the components of a plant and animal cell.

2.3 Identify and describe variations among different types of human cells.

3.0 Describe the process of mitosis.
3.1 Describe the factors that limit cell size.

4.0 Describe the structure of a cell membrane.
4.1 Differentiate between the terms permeable, selectively permeable, impermeable.
4.2 Describe the processes whereby materials are transferred across a membrane.

EXTENSIONS

Cell Theory

The student should be able to:

1.0 State the cell theory.

2.0 Relate the contribution of the following scholars to the development of the cell theory:

- Leeuwenhoek
- Hooke
- Schleiden
- Schwann
- Virchow
- Ruska
- Robert Brown

Levels of Organization

The student should be able to:

1.0 Describe the various levels of structural organization of the body.

Careers

The student should be able to:

1.0 Identify career possibilities in cytology and histology.

Unit II: Biochemistry

The student should be able to:

1.0 Draw a simple Bohr atom diagram given the atomic number and mass.
1.1 Define isotopes.
1.2 Diagram the formation of an ionic bond between two atoms.
1.3 Explain pH in terms of the pH scale and the importance of pH to biological events.
1.4 Diagram the formation of covalent bonds between atoms.
1.5 Write and interpret simple chemical formulas given the symbols and valencies of the elements involved.

NOTE: Some or all of the following biochemistry labs can be integrated with the unit on digestion.

2.0 Write the empirical formula for carbohydrates (CH_2O).
2.1 Draw the structural formula of a glucose molecule.
2.2 Describe the relationship between mono-, di-, and polysaccharides.
2.3 Describe the uses of carbohydrates in the body.

3.0 Give a chemical definition of a protein.
3.1 Identify the general structural formula of an amino acid.
3.2 Identify a peptide bond in a protein chain.
3.3 State the role of dietary protein in the maintenance of homeostasis.

4.0 Give a chemical definition of a lipid.
4.1 Identify a simple structural formula of a lipid.
4.2 Describe the uses of lipids in the body.

5.0 Give a simple definition of an enzyme.
5.1 Describe the synthetic and degradative action of enzymes using the lock and key model.
5.2 List the factors that affect enzyme action.
5.3 Describe the use of enzymes in digestion.

Unit III: Digestion

The student should be able to:

1.0 Identify the structure and function of the human digestive system.
1.1 Describe methods of mechanical digestion.
1.2 Identify the stages of physical breakdown of food through the digestive tract.

2.0 Describe the role of enzymes in human digestion and how specific enzymes operate at given digestion sites.

2.1 Identify the end products of digestion.
2.2 Describe the metabolism and storage of lipids in the body.
2.3 Compare the effects of saturated and unsaturated fats on your health.

EXTENSIONS

Digestive Malfunctions

The student should be able to:

1.0 List and describe the following human digestive malfunctions:

- appendicitis
- ulcers
- enteritis
- hepatitis
- constipation
- dysentery
- diarrhea
- anorexia nervosa
- bulimia

Diet and Nutrition

The student should be able to:

1.0 Describe the role of vitamins and minerals in the human diet.

Obesity

The student should be able to:

1.0 Describe the cause(s) and treatment of obesity.

Balanced Diets

The student should be able to:

1.0 Do a diet survey.

Food Additives

The student should be able to:

1.0 State the effects of various food additives.

Unit IV: Transportation

The student should be able to:

1.0 Identify the anatomical components of the human heart and their related functions.
1.1 Trace the pathway of blood flow through the human heart and associated vessels and organs.
1.2 Identify factors responsible for the regulation of the human heartbeat.
1.3 Differentiate between the systolic and diastolic stages of the heartbeat.

2.0 Identify types of heart diseases, define heart failure, and describe the cause(s) and treatment(s).

3.0 Compare the structure of arteries, arterioles, capillaries, venules and veins.
3.1 Relate the structure of the capillary to its role as the site of exchange in the circulatory system.

4.0 Compare the structure, function and site of manufacture of the formed elements of the blood.

4.1 Describe blood groups, including Rh.
4.2 Describe the components of the blood clotting mechanism.

5.0 Describe the role of the circulatory system in homeostasis.
5.1 Describe the role of the circulatory system in immunity.

6.0 Describe lymph nodes with regard to i) sites, ii) structure, and iii) function.
6.1 Describe lymphatic circulation with regard to i) function, ii) means of transportation, and iii) its association with the blood circulatory system.
6.2 Compare structure and functions of the lymphatic system to the blood circulatory system.

EXTENSIONS

Anticoagulants

The student should be able to:

1.0 Discuss the use of natural and synthetic anticoagulants.

Blood Disorders

The student should be able to:

1.0 Investigate selected blood disorders.

Fitness of Cardiovascular Systems

The student should be able to:

1.0 Describe the effect of diet, lifestyle, physical condition and age on blood and the cardiovascular systems.

Comparative Anatomy of Circulatory Systems

The student should be able to:

1.0 Compare the circulatory systems of selected organisms.

Circulatory Disorders

The student should be able to:

1.0 Investigate the types, causes and treatment of malfunction of arteries and veins.

Body Defense

The student should be able to:

1.0 Discuss body defenses and phagocytosis.

Immunity

The student should be able to:

1.0 Describe the role of the lymphatic system in immune reactions.

Fetal Circulation

The student should be able to:

1.0 Discuss the differences in an adult and fetal circulation.

Lymphatics and Digestion

The student should be able to:

1.0 Explain how the lymphatic system is involved in the absorption of nutrients.

Unit V: Respiratory System

The student should be able to:

1.0 Differentiate between internal and external respiration.
1.1 Identify the structure and function of the respiratory system.
1.2 Compare the mechanics of inspiration to that of expiration.

2.0 Describe the interaction between the respiratory and circulatory systems.
2.1 Describe the role of hemoglobin in respiration.

3.0 Describe the defence mechanisms of the respiratory system.

EXTENSIONS

Disorders of the Respiratory System

The student should be able to:

1.0 Discuss the effect of several lifestyle factors on the respiratory system.
1.1 Explain the cause, symptoms and treatment of several important respiratory disorders.

Comparative Anatomy and Physiology of Respiratory Systems

The student should be able to:

1.0 Identify a variety of mechanisms by which animals accomplish gas exchange.
1.1 Relate the efficiency of gas exchange to the metabolic requirements of the organism.

Heart-Lung Machine

The student should be able to:

1.0 Compare the function of the heart-lung machine with the physiology of the human respiratory system.

Unit VI: Excretory System

The student should be able to:

1.0 Identify the parts of the human excretory system and their functions.

2.0 Apply the concepts of osmosis, diffusion and active transport to functional parts of the nephron.
2.1 Describe the filtering mechanism and the reabsorptive stages of the nephron.

3.0 Describe the role of the excretory system in homeostasis.

4.0 List and describe the constituents of urine.

EXTENSIONS

Malfunctions

The student should be able to:

1.0 Identify the following malfunctions of the excretory system:
- urinary calculi
- urethritis
- renal failure
- loss of urinary bladder control

2.0 Describe kidney dialysis and the Continuous Ambulatory Peritoneal Dialysis methods of kidney support.

3.0 Review the successes and failures of kidney transplants.

Unit VII: Nervous System

The student should be able to:

1.0 Identify the function of parts of the nervous system. Describe the importance of the following processes to nerve system function:
- reception
- interpretation
- sorting and transmission

1.1 Identify the structural parts of sensory, motor and association neurons.
1.2 Describe the arrangement of neurons in a reflex arc.
1.3 Discuss the mechanisms of nerve impulse propagation in terms of a simplified model.

2.0 Identify the parts of the central nervous system.
2.1 Discuss the role of the brain and spinal cord in the central nervous system.

3.0 Identify the components of the peripheral nervous system.
3.1 Explain the mechanism by which the peripheral system regulates the activities of involuntary organs to achieve homeostasis.

4.0 Identify the sensory receptors of the body.
4.1 Identify the structure and function of the parts of the eye and ear.
4.2 Relate the (events) processes of seeing and hearing to nervous system activity.

EXTENSIONS

Disorders of the Nervous System and Its Receptors

The student should be able to:

1.0 Describe the causes, effects and treatment of common nervous disorders, e.g., stroke, epilepsy, multiple sclerosis, meningitis, concussion, Parkinson's disease.

Pain Control

The student should be able to:

1.0 Describe the current hypothesis of pain production.
1.1 Explain the effects of culture and mental state on the sensation of pain.
1.2 Examine the methods by which pain is controlled.

Chemicals and the Nervous System

The student should be able to:

1.0 Discuss critically the physiological effects of depressants on the nervous system.

Unit VIII: Endocrine System

The student should be able to:

1.0 Identify organs involved in endocrine activity.
1.1 Describe the hormonal control of endocrine glands by the "master" or pituitary gland.
1.2 Describe, for each of the endocrine organs:
. site of manufacture
. hormone secreted
. hormonal function(s)
1.3 Identify the roles of endocrine systems in homeostatic regulation.

EXTENSIONS

Endocrine Disorders

1.0 Describe the following endocrine disorders:
- diabetes mellitus
- diabetes insipidus
- dwarfism
- giantism
- cretinism
- myxedema

under the following headings:
. cause(s)
. symptoms
. treatment

2.0 Describe the relationship of the endocrine system to the hypothalamus.

Unit IX: Reproduction and Development

The student should be able to:

1.0 Identify the major anatomical structures and functions of the male and female reproductive systems.

2.0 Discuss the hormonal regulation of male and female reproductive systems.
2.1 Discuss the menstrual cycle.

3.0 Describe anatomical and physiological barriers to fertility.

4.0 Compare the processes of meiosis and mitosis.
4.1 Describe the process of fertilization.
4.2 Describe the characteristics of human embryonic development during each of the three trimesters of pregnancy.
4.3 Describe parturition.

5.0 Describe methods used in the diagnosis of pregnancy.
5.1 Describe methods used to detect fetal abnormalities.

5.2 Describe the physical changes associated with:
- infancy
- puberty
- middle age
- old age
- death

EXTENSIONS

Birth Control

The student should be able to:

1.0 Describe, from a historical perspective, the various male and female birth control methods (past, present, future).

Diseases of the Reproductive System

The student should be able to:

1.0 Examine diseases of the reproductive system.

Rh Incompatibility

The student should be able to:

1.0 Discuss Rh incompatibility under the headings:
- cause(s)
- symptoms
- treatment(s)

Congenital Birth Defects

The student should be able to:

1.0 Investigate congenital birth defects.

OPTION UNITS

Option A: Cancer

The student should be able to:

1.0 Describe the differences between normal cell growth and the growth of cancerous tissue.
1.1 Distinguish between normal tissue and cancerous tissue.
1.2 Differentiate between the two types of tumors in terms of all characteristics and capacity to spread.
1.3 Describe the four main stages of cancer metastasis and the reasons for early diagnosis.

2.0 List several causes of cancer that are natural and several that are caused by humans.
2.1 Identify the most common cancers of men and women and relate these to specific lifestyles or environmental factors.

3.0 Describe the mechanism by which the body normally removes cancerous cells.
3.1 Identify the methods used in the detection of skin, lung, leukemia, breast, cervical, prostate and testicular cancer.
3.2 Identify the advantages and disadvantages of the three standard forms of cancer treatment.

4.0 Describe the consequences of high-risk activities on your future. Compare potential risks and ways that risks can be lowered.

5.0 Describe the problems of coping with cancer.

6.0 Analyze some misleading presentations of cancer research.

Option B: Basic Ecology

The student should be able to:

1.0 Define the term ecology.

2.0 Identify abiotic and biotic components in the environment.

3.0 Describe bio-geochemical cycles in our environment.

4.0 Define and give examples of an autotroph and heterotroph.
4.1 Identify the heterotroph levels in an ecosystem.
4.2 Define the following ecological terms:
- niche
- food chain
- pyramids
- food webs
- top carnivores

4.3 Define the following terms:
- community
- ecosystem
- biome

5.0 Describe the stages of plant succession.

6.0 Describe the role of weeds in ecology.

7.0 Give an example of the effect of human populations on their environments. Describe potential and actual positive and negative effects and give information to support the statement.

Option C: Population Ecology

The student should be able to:

1.0 Define the term population.

2.0 Describe characteristics of a population, e.g.,
- density
- mortality
- natality
- age ratio
- sex ratio
- migration

2.1 Describe the features of a population growth curve.
2.2 Compare how arithmetic and geometric progressions relate to population growth.
2.3 Describe how natural populations maintain homeostasis.

3.0 Describe interrelationships between populations using the following terms:
- symbiosis
- mutualism
- parasitism
- commensalism
- competition
- predation

4.0 List the stages of human population growth.
4.1 Describe the environmental problems related to the overpopulation of humans.
4.2 Identify possible solutions to the problem of human overpopulation, e.g.,
- economic incentives
- education programs
- selective eugenics
- lifeboat scenario

Option D: Environmental Issues

The student should be able to:

1.0 Describe the historical development of a particular environmentally related issue.

2.0 List advantages and disadvantages related to a particular project or environmental problem.

3.0 Select and organize information perceived pertinent to the issue.

4.0 Clearly state and defend their positions on the project or problem based on the evidence presented.

5.0 Evaluate proposed solutions to the project or problem.

Sample Unit: The Garrison Diversion Project

1.0 Identify the Garrison diversion project as an irrigation project.

2.0 Describe the historical events leading to the proposed Garrison diversion project.

3.0 Locate the geographical sites involved in the Garrison diversion project.

4.0 Identify the political, legal, economic and environmental factors related to the Garrison diversion project.

5.0 List the advantages of the Garrison diversion project.
5.1 List the disadvantages of the Garrison diversion project.
5.2 Discuss the feasibility of the Garrison diversion project.
5.3 State and defend their position on the Garrison diversion project based on evidence presented.
5.4 Discuss possible solutions to the Garrison diversion project.

Option E: Heart Health

The student should be able to:

1.0 Name the organs of the cardiovascular system and discuss their functions.
1.1 Name and locate the major parts of the heart and discuss the functions of each part.
1.2 Trace the pathway of blood through the heart and the vessels of the coronary circulation.
1.3 Discuss the cardiac cycle and explain how it is controlled.

2.0 Identify the components of a normal ECG pattern and relate these to the events of the heartbeat.
2.1 Define and describe cardiac arrhythmia.

3.0 Describe the nature of a heart attack and why it occurs.
3.1 Describe the risk factors for cardiovascular disease and how they affect individuals.

4.0 List and explain the known effects of exercise on the function of the heart and circulation.
4.1 Describe how blood pressure is created and controlled.
4.2 Name the signals for a heart attack and indicate what they may mean.
4.3 List the emergency actions that can be taken in case of a cardiac arrest.

5.0 Describe the causes and effects of the various cardiovascular diseases.
5.1 Describe the various surgical techniques available today for prolonged heart life and health.

Option F: Human Behaviour

The student should be able to:

1.0 Identify examples of innate behaviour.
1.1 Identify various types of learned behaviour (conditioning, habituation, imprinting, trial-and-error, reasoning).
1.2 Compare innate and learned behaviour.

2.0 Identify psychological drives and needs.

3.0 Identify individual differences in visual perception.

4.0 Apply principles of human psychology to consumer marketing.

5.0 Describe various examples of verbal and non-verbal communication.

6.0 Describe various human behavioural disorders, e.g.,
- schizophrenia
- depression
- phobias
- annorexia
- psychoses
- neuroses

6.1 Discuss behaviour modification as a method of treatment and a method of conditioning (brainwashing).

7.0 List trends in current research in human psychology.

Option G: Aging

The student should be able to:

1.0 Describe the biological, sociological and psychological aspects of human aging.

2.0 Compare the aging process in unicellular and multicellular organisms.

3.0 Describe aging related diseases and disorders, e.g., progeria, arteriosclerosis, senile dementia.

4.0 Describe individuals and communities with extended life spans.
4.1 Relate lifestyle to longevity.

5.0 Identify the emphasis of current research in gerontology.
5.1 Investigate the psychological and sociological aspects of aging.

6.0 List the advantages and disadvantages of having a large number of post-reproductive members in our society.

EXTENSIONS

Euthanasia

The student should be able to:

1.0 Identify and evaluate the pros and cons of euthanasia.

A1

A2

Option H: Disease-Causing Organisms in Humans

The student should be able to:

1.0 Describe the morphology of bacteria.
1.1 List the shapes and grouping of bacteria.
1.2 Discuss factors related to bacterial growth.
1.3 Describe two ways in which bacteria cause disease.
1.4 Describe the symptoms, transmission, and treatment of some common communicable diseases.
1.5 Describe defences against bacterial disease made by humans.

Viruses

The student should be able to:

1.0 Describe and diagram the life cycle of a virus.

2.0 Describe the symptoms, transmission and treatment of selected viral diseases.

3.0 Discuss the nature of body defences against viral diseases.

Parasites

The student should be able to:

1.0 Define the terms:
- ectoparasites
- endoparasites

2.0 Describe the transmission of an endoparasite (*Plasmodium sp.*).
2.1 Describe the transmission of an ectoparasite.

3.0 Discuss methods of eradicating these parasites.

Fungi

The student should be able to:

1.0 Describe fungi that may cause human disease.

2.0 Discuss the transmission of human diseases caused by fungi.

3.0 Discuss methods of preventing and curing human diseases caused by fungi.

Immunity

The student should be able to:

1.0 Discuss the body's defence against disease causing organisms.

Epidemiology

The student should be able to:

1.0 Discuss the transmission of disease.

2.0 Discuss ways in which transmission may be controlled.

3.0 Discuss the responsibility of the individual and the society for the prevention of transmission of disease.

4.0 Relate the incidence of communicable disease to the economic welfare of a country.

Effects of Isolation

The student should be able to:

1.0 Discuss the relationship between the incidence and virulence of disease and the isolation of the individual or community.

Option I: Sexually Transmitted Diseases (STDs)

The student should be able to:

1.0 Distinguish between bacteria, fungi, viruses and protozoa.
1.1 Describe the symptoms and causative agents of: genital herpes, syphilis, gonorrhea, trichomoniasis, nonspecific urethritis, Candida albicans vaginitis.
1.2 Describe the diagnosis, treatment and prevention of STDs.
1.3 Explain the epidemiology of STDs.
1.4 Describe the pre-, peri- and postnatal effects of STDs.

2.0 Explain the legal and moral implications of STDs.

3.0 Describe the symptoms, causative agent and treatment of pubic lice.

Option J: Support and Movement

The student should be able to:

1.0 Identify the layers and structures that comprise the skin.
1.1 State and test the functions of the skin layers and their associated structures.

2.0 Explain the role of the skin as an excretory organ.

3.0 Explain the role of the skin as a receptor of environ mental stimuli.

4.0 Discuss the homeostatic mechanisms related to the integumentary system.

5.0 Describe the structure of the skeleton.
5.1 Describe the nature of cartilage, bone and white fibrous connective tissue.
5.2 Identify the major bones of the body.
5.3 Identify the kinds of joints found in the skeleton.

6.0 Describe the functions of the skeleton.
6.1 List the five functions of the skeleton.
6.2 Describe the functions of the joints identified in 5.3.
6.3 Outline the functions of bone, cartilage, tendons and ligaments.

7.0 Describe the role of the skeleton in maintaining homeostasis of minerals and blood cells.

8.0 Contrast the structure of visceral, skeletal and cardiac muscle.

9.0 Describe the arrangement of muscles that operate antagonistically and synergistically.
9.1 Describe the relationship of muscle groups to providing physical fitness.

EXTENSIONS

Disorders of the Skin

The student should be able to:

1.0 Describe the cause(s) (where known), symptoms and treatment/prevention of some common skin problems.

Comparative Anatomy of Integumentary Systms

The student should be able to:

1.0 Compare the integumentary structures of several diverse animal types.
1.1 Describe the relationship of the anatomy of different integuments to the environmental conditions faced by organisms.

Muscle Fatigue

The student should be able to:

1.0 Explain the stages in muscle fatigue.

Identification of Muscles

The student should be able to:

1.0 Identify the major groups of skeletal muscles and relate to action of each major group.

Comparison of Skeletal Systems

The student should be able to:

1.0 Compare the skeletal systems of a variety of organisms.

Disorders of Skeletal Systems

The student should be able to:

1.0 Discuss factors that contribute to disorders of the skeletal system.
1.1 Discuss the differences between fractures, dislocations and sprains.

1.2 Identify the relationship between the symptoms of skeletal diseases such as arthritis and osteomyelitis to bone physiology.

Option K: Project or Research

The student should be able to:

1.0 State a hypothesis relating energy produced to food available, e.g., food concentration related to carbon dioxide production in yeast.
1.1 Use scientific processes of observation and interpretation of data to test a hypothesis.
1.2 Review the hypothesis relating to the observed data and accept, reject or modify the data for additional testing.

2.0 Specify some principles of experimental design relating to the design attempted in 1.0-1.2.
2.1 State variables that affected the problem and give potential alternate hypotheses and investigations that could be tested.

Option L: Land Use

(To be redesigned.)

OBJECTIVES FOR BIOLOGY 300

CORE UNITS

Unit 1: Gene Action: DNA/RNA/Protein Synthesis

The student should be able to:

1.0 Describe the physical structure of DNA and how it relates to the physical nature of a chromosome.
1.1 Identify the six molecular components of DNA by name and by simplified molecular (block) diagrams.

1.2 Describe, with the aid of diagrams, the molecular structure of DNA.
1.3 Describe, using simplified diagrams, the replication of the DNA molecule.
1.4 Identify the functions of the DNA molecule.

2.0 Identify the molecular components and draw simplified diagrams of mRNA and tRNA.
2.1 Compare the structure of DNA, mRNA and tRNA.
2.2 Describe the process of protein synthesis, using simplified diagrams.
2.3 Explain why changes in DNA codons may alter the composition of a protein.
2.4 Discuss the implications of codon change to the composition of the protein produced.
2.5 Identify some common conditions which result from faulty protein synthesis, e.g., sickle-cell anemia, phenylketonuria.

3.0 Define mutation and give some examples of factors that cause mutation, e.g., relate the specific effect of ultraviolet light, ethylmethane sulfonate (EMS), Benzpyrene (BP) and replication error on the genetic code.
3.1 Describe examples of spontaneous and induced mutations as they pertain to the genetic code within DNA, e.g., compare the effect of background cosmic radiation to the use of medical radiation to the use of medical radiation and chemical pollutants in the production of mutations.

EXTENSIONS

History of DNA Research

The student should be able to:

1.0 Describe the significant events that led to the present knowledge of DNA structure and function.

Genetic Change and Its Consequences

The student should be able to:

1.0 Describe the effect of chromosomal mutation on the expression of the genetic code, e.g., discuss, using models, such chromosomal mutations as translocation, inversion, deletion and polyploidy.

Unit II: Introduction to Human Genetics

The student should be able to:

1.0 Identify variations in humans which are inherited.
1.1 Investigate the probability of gene transmission.
1.2 Describe the work of Mendel in terms of our present genetic knowledge.
1.3 Define the terms chromosome, gene, allele, phenotype, genotype, heterozygous, homozygous, dominant, recessive.

2.0 Interpret the dominant and recessive characteristics of genes in terms of gene chemical action, e.g., emphasize that gene control is chemical (DNA) control of trait expression.
2.1 Predict the results of monohybrid and dihybrid crosses.
2.2 Prepare a monohybrid pedigree from an analysis of phenotypic characteristics of several generations.
2.3 Describe inherited characteristics determined by multiple genes.

2.4 Describe inherited characteristics determined by multiple alleles of a single gene.
2.5 Describe the effects of environment on the expression of some genes.

3.0 Explain the role of chromosomes in sex determination.
3.1 Relate the mechanism of sex-linked inheritance to the distribution of sex-linked traits.
3.2 Relate abnormal sex chromosome numbers to expression and development of sex traits.
3.3 Identify some causes and consequences of the following genetic abnormalities:
- monosomy
- trisomy
- translocation
- inversion

3.4 Give examples of dominant and recessive metabolic disorders and differentiate between the probabilities of the expression of such traits in the offspring of carriers.

4.0 Describe the process of crossing over between linked genes and its consequences for genetic variation.
4.1 Describe how chromosomes are mapped using crossing over between linked genes.
4.2 Relate recombination to the process of independent assortment and fertilization.

Unit III: Bioenergetics

Photosynthesis

The student should be able to:

1.0 Relate the visible energy spectrum to the total electromagnetic spectrum.

1.1 State the relationship between the colour of a surface and the portion of the energy spectrum that is absorbed, reflected or transmitted.
1.2 Interpret a graph showing the relationship between light absorption by chlorophyll and light wave length.

2.0 Describe the structure of the chloroplast.
2.1 Identify the types of chlorophyll and other photosynthetic pigments.

3.0 Write a summation for photosynthesis:

$$6CO_2+6H_2O \xrightarrow[\text{light}]{\text{energy}} C_6H_{12}O_6+6O_2$$

3.1 Relate factors such as carbon dioxide concentration, temperature and light intensity to the rate of photosynthesis.
3.2 Identify the products of photosynthesis, including "photo-phosphorylation" using simplified diagrams.
3.3 Interpret the chemical events of the light and dark reactions using simplified diagrams.

4.0 Relate the process of photosynthesis to the variations in structure and function of plant organs.

5.0 Relate the environmental and economic importance of photosynthesis to food, fuel and oxygen production.

Cell Respiration

The student should be able to:

1.0 Write and interpret the summation equation for aerobic respiration. The representative equation is:

$$C_6H_{12}O_6+6O_2 \longrightarrow 6CO_2+6H_2O + \text{energy}$$

1.1 Write and interpret the equation for the production of ATP in aerobic respiration:
$ADP + P \longrightarrow ATP$
1.2 Give examples of the use of energy from ATP in the human body.

2.0 Write and interpret the summation equation for anaerobic respiration. The representative equation is: $C_6H_{12}O_6 \longrightarrow 2C_2H_5OH + 2CO_2$

2.1 Relate the occurrence of aerobic respiration to the complexity of an organism and compare the advantages of aerobic and anaerobic respiration.

3.0 Interpret the Krebs Cycle, using simplified diagrams to illustrate the intermediary stages of respiration that are needed to convert carbohydrates, proteins and fats into energy.
3.1 Draw a simplified diagram of the electron transfer chain.

4.0 Describe the relationship between photosynthesis, respiration and the carbon hydrogen and oxygen cycle.

Unit IV-A: Variety in Animals

The student should be able to:

1.0 Describe the criteria by which animals are organized into groups.

2.0 Identify the main distinguishing characteristics of the major phyla.

2.1 Use an identification key effectively.
2.2 Explain the limitations of classification systems.
2.3 Relate phylogenetic position to evolutionary progress.

3.0 Identify the main distinguishing characteristics of the following chordate classes:

- Agnatha
- Chondrichthyes
- Osteichthyzes
- Amphibia
- Reptilia
- Aves
- Mammalia

NOTE TO TEACHERS: Stress the evolutionary themes evident from examination of these classes.

4.0 Trace the evolutionary changes that have occurred in the structure of a vertebrate system.
4.1 Discuss the adaptive significance of these changes.
4.2 Examine an organism and infer the type of environment to which it is adapted.

EXTENSIONS

Adaptation

The student should be able to:

1.0 Identify the particular stresses that each of the following environments place on an animal:

- marine
- freshwater
- arctic
- temperate
- tropical
- arid
- humid

1.1 Give examples of how animals have adapted to each of the stresses identified in 1.0.
1.2 Infer the environment(s) to which an animal is adapted by examination of one or more of its structural characteristics.
1.3 Predict the changes that might occur in an animal population over a long period of time in response to a specific environmental change.

Unit IV-B: Variety in Plants

The student should be able to:

1.0 Describe the general features of four types of green algae: unicellular, filamentous, colonial and multicellular.
1.1 Trace the development of division of labour, using algae as an example.
1.2 Describe, compare and contrast isogamy, heterogamy and conjugation.
1.3 Describe vegetative reproduction in algae.
1.4 Apply the concept of vegetative reproduction to higher plants, e.g., in horticulture.

2.0 List problems of adaptation for plants in a terrestrial environment which are not found in an aquatic environment.
2.1 Describe the life cycle of a moss.
2.2 Describe the structure of a moss.
2.3 State how (2.1) and (2.2) are adaptations to a terrestrial environment.
2.4 State difficulties in a terrestrial environment which the mosses have not overcome completely.

3.0 Define the term angiosperm.
3.1 Define the term gymnosperm.
3.2 Describe how flowering plants have adapted to a terrestrial existence.

4.0 Define and give one example of a mesophyte, a hydrophyte, and a xerophyte.
4.1 Contrast hydrophyte and xerophyte structures and relate them to the environment.
4.2 Discuss the evolutionary reasons for the decline of the gametophyte.
4.3 Explain how plants respond to short-term environmental changes.
4.4 Explain dormancy, photoperiodism, leaf loss, germination, tropism, auxin, cytokinin.

EXTENSIONS

Fungi

The student should be able to:

1.0 Diagram the structures of a typical fungi, e.g., penicillin.
1.1 Describe the heterotrophic nutrition of a fungi and the difference between a parasite and a saprophyte.
1.2 Describe some common parasitic fungi and their significance to agriculture, e.g., corn smut, wheat rust.
1.3 Describe the economic, biological and medical importance of fungi in the areas of plant disease/decomposition and antibiotics/food products.

Lichen

The student should be able to:

1.0 Describe the structure of a lichen.
1.1 Discuss the symbiotic relationship found in a lichen, showing the advantages of symbiosis.

Chemical Technology

1.0 Give some examples of how science and technology improve yields in modern agriculture.
1.1 Discuss the benefits and dangers inherent in the use of chemicals in agriculture.
1.2 Discuss the need to preserve wild plant species as a seed resource.

Unit V: Angiosperms

The student should be able to:

1.0 List the parts of a generalized plant cell: cell wall, membrane, chloroplasts, vacuole and cytoplasm.
1.1 Describe the structure and functions of each of the above.

2.0 Define three functions of a root.
2.1 Identify the tissue types found in a root cross-section.
2.2 State the characteristics of each tissue type.
2.3 Define the functions of each tissue type.
2.4 Describe the mechanics of the uptake of water and minerals by the root hair.

3.0 Define the functions of a stem.
3.1 Identify the tissue types found in a stem.
3.2 State the characteristics of each tissue and relate them to similar tissues in the root.
3.3 Define the function of each tissue and relate it to root functions.
3.4 Describe mechanics of the transportation of materials up and down a stem.

4.0 Relate the role of chlorophyll, water, carbon dioxide and light to the photosynthetic reaction.
4.1 State the function of the leaf.
4.2 Identify the tissue types found in a dicot leaf.
4.3 Describe the structure and function of each tissue type.
4.4 Describe the structure and function of stomata.

5.0 Identify the calyx, corolla, stamen and pistils.
5.1 Describe the structure and function of the elements in 5.0.
5.2 Describe the formation of a megaspore and a microspore.
5.3 Describe the process of fertilization.
5.4 Relate the process of pollination and fertilization to its evolutionary significance.

6.0 Describe the structure and function of a seed.
6.1 Describe the development of seeds and fruit.
6.2 Describe the function of the fruit.
6.3 Relate germination to some of the conditions which affect it, e.g., temperature, humidity.

7.0 Describe the factors which cause malfunctions in plants. Discuss dehydration, mineral deficiencies, insects, diseases.
7.1 Describe the significance of plant life to the economy and the environment.

OPTION UNITS

Option A: Anthropology

The student should be able to:

1.0 Identify the difficulties faced by anthropologists in the practice of anthropology as a science.
1.1 Describe the contributions of and views on human origin held by some important anthropologists.

2.0 Identify the main primate characteristics.
2.1 Identify the main primate groups.
2.2 Describe the general events in the evolution of primate types.

3.0 Describe the possible time of existence, range of occurrence, and mode of existence characteristic of the hominids found in the fossil record.

4.0 Discuss the role of culture and kinship in the success of humans to survive in a variety of environments.

5.0 Describe the methods used by anthropologists to investigate human origin.

6.0 Identify the main factors in the cultural evolution of humans.

EXTENSIONS

NOTE: The following extensions examine in depth some of the more recent developments in anthropology. They require a wider source of references and, in this light, a partial list of some of the more useful and recent publications is given at the beginning of this unit. Included are some suggested films.

Fossil Analysis

The student should be able to:

1.0 Describe some of the more exotic ways in which fossil fuels and ancient habitats are analyzed.
1.1 Describe the use of biochemical comparisons to interpret evolutional relationships.

The Origin of Bipedalism

The student should be able to:

1.0 Rank the relative importance of several environmental factors to the evolution of bipedalism.

Origin and Evolution of Communication

The student should be able to:

1.0 Describe the significant events in the development of communication.

Social Order

The student should be able to:

1.0 Suggest possible events and factors that could lead to recognition of kinship.

2.0 Describe the fossil evidence that shows the development of human's interest in ritualism and spiritualism.

Physical Anthropology

The student should be able to:

1.0 Identify the unique features of the human skeleton as compared to other primates.
1.1 Suggest reasons for the evolution of these unique traits.

Option B: Histology

The student should be able to:

1.0 Define the term histology.

2.0 Describe how tissues are prepared for examination.
2.1 Contrast fixation and frozen section methods of preparation.

3.0 Describe and identify the following normal tissues:
- epithelial
- connective
- nervous
- muscle

4.0 Describe an organ from a histological viewpoint.

5.0 Discuss the significance of histology.

6.0 Evalute careers in histology.

Option C: Microbiology

Sub-Option 1: Bacteriology

The student should be able to:

1.0 Describe the basic classification system for microorganisms.

2.0 Describe the morphology, cell structure and growth of bacteria.

3.0 Describe safe laboratory methods used to culture bacteria.

4.0 Describe methods of controlling the growth of bacteria.

5.0 Identify Gram-negative and Gram-positive bacteria.
5.1 Prepare a bacteriological smear.
5.2 Perform a Gram Stain.

6.0 Categorize bacteria using correct nomenclature.

7.0 Describe characteristics of some strains of bacteria.

8.0 Describe characteristics of the enteric bacilli.

9.0 Describe characteristics of the Clostridia sp.--the spore-forming anaerobes.

10.0 Describe characteristics of mycobacterium.

11.0 Compare careers in microbiology with those in histology.

Sub-Option 2: Mycology

The student should be able to:

1.0 Use a microscope to identify spores, sporangium, hypha and mycellium of fungi.
1.1 Describe the function of each of the above structures.
1.2 Distinguish between an obligate parasite and an obligate saprophyte.
1.3 Diagram a life cycle, e.g., Puccinia graminis.
1.4 Culture and identify molds in the laboratory or in the field, weather permitting.

2.0 Differentiate between a fungal, viral and bacterial disease.
2.1 List the symptoms and methods of treatment for the common fungal diseases of humans--Tinea's, Candida albicans and aspergilliosis.

3.0 Diagram the life cycle of wheat rust.
3.1 List methods of control of wheat rust.
3.2 Diagram the life cycle of corn smut.
3.3 List methods of control of corn smut.
3.4 Describe the importation of Dutch elm disease.
3.5 Diagram the life cycle of Dutch elm disease.
3.6 List possible methods of control of Dutch elm disease.
3.7 Compare economic costs of fungal diseases of humans to fungal diseases of plants.

4.0 Describe the atypical nature of yeast.
4.1 Write the equation for anaerobic respiration.
4.2 Describe the importance of yeast to the brewing and baking industries.
4.3 Name and identify several edible fungi, e.g., morels, truffles, blue cheese.
4.4 Define antibiotics and describe discovery of penicillin.
4.5 Discuss the fungi as sources of hallucinogens.

Careers

- technologist
- mycologist
- microbiologist
- mushroom farm worker
- pharmacist
- sewage plant operator

Sub-Option 3: Parasitology

The student should be able to:

1.0 Define the terms:
- parasitology
- ectoparasites
- endoparasites

2.0 Describe the structure and pathogenicity of the spirochetes.

3.0 Describe parasites common to humans.
3.1 Identify ova and adults of the selected parasites.
3.2 Describe trypanosomes.
3.3 Describe the life cycle of one parasite.
3.4 Describe the effects of parasites on the economy of a selected area and give potential biological solutions.

4.0 Describe careers in parasitology.

Sub-Option 4: Virology

The student should be able to:

1.0 Describe the structure of viruses.
1.1 Describe the reproduction of viruses.
1.2 List ways viruses affect humans and other living things.
1.3 Describe defences against viral infections.
1.4 Describe the effects of viral infections.
1.5 Differentiate bacterial and viral conditions.

2.0 Describe viral diseases of humans.

3.0 Describe bacteriophage (the bacterial viruses).

4.0 Compare careers in virology and microbiology.

Option D: Health Care and Health

The student should be able to:

1.0 Place modern medical procedures in an historical context.

2.0 Describe the roles of various practitioners in the area of health care, e.g., surgeons, family practitioners, nurses, licensed practical nurses, orderlies, pharmacists, laboratory technologists, physio and occupational therapists, dental surgeons, dentists, dental nurses, oral hygienists, opthalmologists, chiropractors, nutritionists.

3.0 Discuss the personal and societal rationale for and consequences of specific medical procedures.

4.0 Evaluate the costs and benefits of specific aspects of medical care.

5.0 Distinguish between degenerative diseases, infectious disease and trauma.
5.1 Distinguish between preventive and therapeutic medicine.
5.2 Discuss how the adoption of a particular lifestyle can affect one's health and thus the cost of medical and health care.

Option E: Plants and Agriculture

The student should be able to:

1.0 Describe the structure of a root, stem, leaf and flower.
1.1 Write the summary equation for photosynthesis.

2.0 Diagram the carbon, nitrogen and phosphate cycles.
2.1 List the major uses of carbon, nitrogen and phosphates by plants.
2.2 Compare the acquisition and use of these chemicals by plants and animals.

3.0 Name the three major components of fertilizer and relate these three nutrient cycles (carbon, nitrogen, phosphate) to each other.
3.1 Distinguish between a pesticide, a herbicide, an insecticide, a selective weed killer, and a soil sterilant. Give an example of each.
3.2 Weigh the consequences of increased use versus desired results of the use of chemicals in agriculture.
3.3 Examine the pros and cons of specific agricultural practices and relate these to agriculture success.

4.0 Distinguish between a fungus, a bacterium, a nematode and an insect.
4.1 Describe the methods that can be used to control agricultural pests and explain the physiology of their effect.
4.2 Describe the dangers to the environment and to humans which result from the use of some of the methods to control agriculture pests.

5.0 Identify the factors involved in a selected aspect of the politics of food production.
5.1 Discuss the advantages and disadvantages of absentee farm ownership.
5.2 State the requirements that must be met under provincial and local laws for foreigners to own Manitoba land.

6.0 Describe briefly the recent advances being made in agricultural practices.
6.1 Describe the requirements for and duties of some occupations related to agriculture.

Option F: Origin and Evolution of Life

The student should be able to:

1.0 Describe the theory of spontaneous generation and give some "examples" of it.
1.1 Describe and compare the works of Redi, Needham, Spallanzani, Pouchet and Pasteur to disprove the theory of spontaneous generation.

2.0 Give a scientific hypothesis for the formation of planets such as the earth.
2.1 List the probable components of the earth's original atmosphere.
2.2 Describe the mechanisms by which organic compounds could have been produced under original earth conditions.
2.3 Describe how the heterotroph hypothesis explains the origin of life on earth.
2.4 Compare the structures of "l" and "d" isomers to their functions.
2.5 Describe the findings of Murchison. Discuss the significance of his findings.
2.6 State the significant aspects of the cell symbiosis hypothesis.
2.7 Describe how the development of photosynthesis affected the earth's atmosphere and evolutionary conditions.

3.0 Define the terms species, gene pool, variation and adaptations.
3.1 Describe the historical development of the concept of evolution.

4.0 Identify the experiences and observations of Darwin that convinced him that evolution occurred.
4.1 Describe the mechanism of natural selection according to Darwin.
4.2 Discuss the factors that influenced Darwin in arriving at his interpretation of the process of evolution.

5.0 Describe the mechanism of punctuated equilibrium as it applies to the process of evolution.
5.1 Compare natural selection/gradualism to punctuated equilibrium and identify the differences.
5.2 Cite evidence that points to the punctuated equilibrium model of evolution.

6.0 Specify potential roles of mutation, genetic recombination, isolation, migration and genetic drift, evolution of new species and species multiplication.
6.1 Compare the evolutionary results of divergence, convergence, adaptive radiation and progressionism.

7.0 Describe the techniques used by paleobiologists to analyze the fossil record.

8.0 Identify the major geological eras used to describe the fossil record.
8.1 Identify the sequence of major evolutionary events as currently shown by the fossil record.

EXTENSIONS

The Hardy-Weinberg Principle

The student should be able to:

1.0 State the Hardy-Weinberg Law.
1.1 Use the law to predict genotype and phenotype ratios.
1.2 List the conditions under which the law applies.

Option G: The New Genetics: An Issues Approach

The student should be able to:

1.0 Define "inborn error of metabolism."
1.1 Explain how mutations affect the genetic code and lead to the synthesis of defective enzymes and other proteins.
1.2 Give examples of the ways genetic diseases can be detected.

2.0 Relate how deviations from the normal number and pattern of human chromosomes give rise to genetic abnormalities.
2.1 Recognize the causes of chromosomal anomalies, e.g., non-disjunction, translocation, inversion, deletion and duplication.

3.0 Differentiate between genetic and non-genetic fetal abnormalities.
3.1 List various corrective and preventive measures which can reduce the incidence of genetic diseases.
3.2 Identify ethical and social issues involved in screening for genetic diseases.

Option H: Project or Research

The student should be able to:

1.0 State a hypothesis relating energy produced to food available, e.g., food concentration related to carbon dioxide production in yeast.
1.1 Use science processes of observation and interpretation of data to test a hypothesis.
1.2 Review the hypothesis in terms of the observed data and accept, reject or modify the data for additional testing.

2.0 Specify some principles of experimental design in relation to the design attempted in 1.0-1.2.
2.1 State potential variables that could affect the problem and state potential alternative hypotheses and investigations that could be tested.

CURRICULUM ADOPTION AND IMPLEMENTATION

Curriculum adoption takes place when the curriculum guide is formally introduced, when new materials are purchased and when orientation sessions are provided. Curriculum adoption is different from curriculum implementation, which is a long-term process of several stages which requires continuous commitment and action and which results in measurable differences in classroom practices and student behaviour. Adoption of this new biology curriculum is expected to begin in September, 1986, soon after distribution of guides and the scheduling of in-service sessions. Implementation will begin in September, 1987 and is expected to take place in stages over a three-year period.

The purchase of new texts is normally a part of the adoption procedure which precedes the implementation phase. For Biology 201 and 301, however, the purchase of new materials may not be necessary at the beginning, but will not, in any case, take place until the second stage of implementation, after teachers have had an opportunity to assess the merits of new materials and test them in classroom practice.

THE ROLE OF THE TEACHER

Two implementation stages are recommended for the new biology curriculum. In the first stage, teachers should become familiar with the rationale and general design of the program, the objectives, and some of the general implications of the change. Teachers should examine and try using in class some of the support materials (in limited quantities) to become familiar with their strengths and weaknesses, the ways which they can be used and combined, and the changes that may be necessary in laboratory activities. Working with the support materials will give teachers an opportunity to decide whether changes in teaching methods will be necessary.

In the second stage, teachers should begin full-scale implementation of the new program, combining new materials with old texts, introducing new modules and laboratory activities and determining organizational needs and key activities for new topics. Some of the new units (such as Research Project or Human Genetics and Issues) will likely involve organizational changes. The unit design charts provided in this guide will provide some specific information regarding such changes.

POSSIBLE TIME-LINE

1985-86 Curriculum adoption (familiarization with the objectives and the guide)
- development of a general plan for implementation
- review of new materials; attempt of ideas from alternate core texts
- attempt at one or more of the science, technology society units using sample materials as teacher resources
- determination of new laboratory activities and equipment requirements

1986-87 Full-scale curriculum implementation
- introduction of the science, technology, society units
- definition of needs for alternate core texts and/or modules
- purchase of materials for above

THE ROLE OF THE ADMINISTRATOR

Administrators may wish to familiarize themselves with the new curriculum and consider its implications for the

purchase of new materials, whether they be alternate core texts or support materials for the option units.

Administrators can support the process of implementation by:

- allowing time for the development of local expertise on alternate texts and options during the first year of implementation;
- developing a plan for implementation based on specific needs, for example, the development of a local option to meet those needs and the science, technology, society objective (development could involve the cooperative effort of two or more schools);
- providing a fund for obtaining laboratory materials to implement suggested "core" labs;
- considering the preparation time required by the teacher to provide an emphasis upon laboratory and field activities.

SCOPE AND SEQUENCE FOR BIOLOGY 200 CORE

	Cells	Bio-chemistry	Digestion	Transport	Excretory	Respiratory	Nervous	Endocrine	Reproduc-tion
SUBTOPICS	structure and function of cell parts comparison of plant and animal cells transport mitosis cell theory	simple bonding pH chemical formulae structure, function and metabolism of carbohy-drates, lipids, proteins	structure and function role of enzymes homeostasis	components regulatory factors disease and treatment blood elements--structure and function lymph system--structure and function homeostasis	components--structure and function diffusion--filtering and the kidney homeostasis	components--structure and function interaction--respiratory and circu-latory defense mechanisms and homeostasis	components--structure and function impulse propagation and reflex arc peripheral system sensory receptors	hormonal functions of organs pituitary control function homeostasis	anatomical structure and functions of systems hormonal regulation and cycles fertility factors and control meiosis and mitosis embryo and fetus development

PROCESS AND SKILLS FOR CORE LABS

Biology 200 / Laboratory Activity	Unit	Observing	Classifying	Quantifying	Formulating Hypotheses	Using Operational Definitions	Controlling Variables	Communicating	Interpreting Data	Model Building	Inferring	Predicting	Psychomotor Skills
1. Use of Light Microscope	I	X		X			X	X		X			X
2. Techniques for Microscope	I	X		X			X	X		X	X		X
3. Carbohydrates (C + I)	II III	X	X		X			X	X	X	X	X	X
4. Proteins	II III	X	X		X			X	X	X	X	X	X
5. Fats	II III	X	X		X			X	X	X	X	X	X
6. Enzyme Action	II III	X		X	X	X	X	X	X	X	X	X	X
7. The Human Heart	IV	X		X	X		X	X	X		X	X	X
8. Blood and Blood Typing	IV	X	X					X	X		X	X	X
9. The Stethoscope	IV	X						X	X				X
10. Blood Pressure	IV	X		X			X	X	X	X	X	X	X

Biology 200 / Laboratory Activity	Unit	Observing	Classifying	Quantifying	Formulating Hypotheses	Using Operational Definitions	Controlling Variables	Communicating	Interpreting Data	Model Building	Inferring	Predicting	Psychomotor Skills
11. Your Heart and Exercise	IV	X	X	X	X			X	X		X	X	X
12. Respiration Value	V	X		X	X	X	X	X	X		X	X	X
13. Cell Membrane	VI	X		X	X		X	X	X	X	X	X	X
14. Urine Analysis	VI	X	X	X	X		X	X	X		X	X	X
15. The Eye	VII	X		X				X	X	X	X	X	X
16. Reaction Time	VII	X		X				X	X	X	X	X	X
17. Human Reflex	VII	X		X				X	X	X	X	X	X
18. Thyroid	VIII	X				X		X			X	X	
19. Mitosis Versus Meiosis	IX	X	X	X				X	X	X			
20. Menstrual Cycle	IX	X						X	X	X		X	
21. Fetal Pig or Other Mammal	IX	X						X		X	X	X	X

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SCOPE AND SEQUENCE FOR BIOLOGY 300 CORE

	Heredity	DNA/RNA	Photo-synthesis	Cell Respiration	Varieties		Angiosperms
					Plants	Animals	
SUBTOPICS	human variation Mendel's work gene action crosses multiple allele inheritance sex determination and sex-linked inheritance abnormalities crossing over	structure and components replication components and process mutation-nature and factors	rate control factors light and dark reactions photo-synthesis and plant organs evolution environmental and economic importance	equations-aerobic and anaerobic respiration complexity and respiration Kreb's Cycle and energy	types of algae, division of labour, and reproduction vegetative reproduction in higher plants mosses, flowering plants and adaptation	organizing criteria main characteristics of phyla limitations of class system main characteristics of chordate classes evolutionary influence changes in structure of a vertebrate system	structure and function of systems, tissue types, and parts factors affecting function

PROCESSES AND SKILLS FOR CORE LABS

Biology 300 / Laboratory Activity	Unit	Observing	Classifying	Quantifying	Formulating Hypotheses	Using Operational Definitions	Controlling Variables	Communicating	Interpreting Data	Model Building	Inferring	Predicting	Psychomotor Skills
1. DNA - RNA	I	X	X		X	X		X	X	X	X	X	
2. RNA and Protein	I	X	X		X	X		X	X	X	X	X	
3. Finding Genotypes and Phenotypes (1 Trait)	II	X	X	X	X	X		X	X		X	X	
4. Finding Genotypes and Phenotypes (2 Traits)	II	X	X	X	X	X		X	X		X	X	
5. A Chromosome Study	II	X	X		X			X	X		X	X	
6. Heredity or Environment	II	X	X	X	X	X		X	X		X	X	X
7. Sex Linked or Non-Sex Linked	II	X	X	X	X	X		X	X		X	X	
8. Chloroplast Pigment Analysis	III	X		X				X	X		X	X	X
9. Leaf Anatomy	III	X	X					X	X	X	X	X	X
10. Yeast Respiration	III	X						X	X		X	X	X

Biology 300 / Laboratory Activity	Unit	Observing	Classifying	Quantifying	Formulating Hypotheses	Using Operational Definitions	Controlling Variables	Communicating	Interpreting Data	Model Building	Inferring	Predicting	Psychomotor Skills
11. Muscular Activity	III	X		X	X		X	X	X		X	X	X
12. Survey of Animal Phyla	IVA	X	X					X					
13. Earthworm	IVA	X	X		X	X		X		X	X		X
14. Anthropods	IVA	X	X		X	X		X		X	X		X
15. Starfish	IVA	X	X		X	X		X		X	X		X
16. Using and Making Biological Key	IVA	X	X					X	X	X	X	X	
17. Lichens	IVB	X	X		X	X		X	X		X		X
18. Algae	IVB	X	X		X	X		X	X		X		X
19. Liverworts, Mosses	IVB	X	X		X	X		X	X		X		X
20. Reproductive Fungi	IVB	X	X		X	X		X	X		X		X
21. Flower Anatomy	V	X	X					X		X	X	X	X
22. Stems and Roots	V	X	X					X		X	X	X	X
23. Fruit and Seeds	V	X	X					X		X	X	X	X
24. Auxin-Root Growth	V	X		X	X	X	X	X	X	X	X	X	X

program implementation

PROGRAM IMPLEMENTATION

The Biology 200 and 300 program is represented by the curriculum objectives stated in the first section of this guide. Teachers should refer to the program section for information on the expectations for the course and to the unit design charts for teaching ideas and suggested materials. Textual materials will vary in their usefulness in supporting specific objectives.

TIME ALLOTMENTS

Time allotments for Biology 200 and 300 are 110 hours per course. The core portion of the program requires 65-70% of the available time; the remaining 30-35% is to be devoted to the option units. Two or three optional units are to be completed per grade in that time. In the core program for Biology 200, teachers may wish either to choose two or three options or to replace some or all of the options with the extensions suggested at the end of each core unit.

STRUCTURE OF THE PROGRAM

Biology 200 contains nine core units and two optional units. The sequence of the core units suggested in the guide may be modified. Units from the option area could be completed at the end of the core, or some units (such as Heart Health or Cancer) could readily be correlated with appropriate core units.

Biology 300 consists of seven core units and two or three units from the option area. The sequence of the core units should be followed as given. Depending on the choice of topics from the designed options, a topic can be related to specific core units or may be integrated into a number of units. The New Genetics: An Issues Approach could be related to the core genetics unit and Plants and Agriculture could integrated with Angiosperms.

The core objectives for both Biology 200 and 300 are prescriptive and attempt to provide the necessary learning outcomes both for general knowledge and for students who intend to continue their studies in biology. For both, the sequencing of specific objectives within each unit can be modified according to materials used, the background of students or other variables.

The core portion of the new program should be relatively familiar to biology teachers. The option portion of the program which deals with the relationship of science to technology and society may contain relatively familiar content (such as Support and Movement) or unfamiliar content (such as Agriculture or The New Genetics). It may also contain familiar techniques such as testing for proteins or unfamiliar techniques such as simulations (dealing with the resolution of a pollution problem). Teachers should become familiar with the differences among the units and potential starting points in teaching a new unit. The piloting process indicated that there was sufficient time to develop both the core and the options.

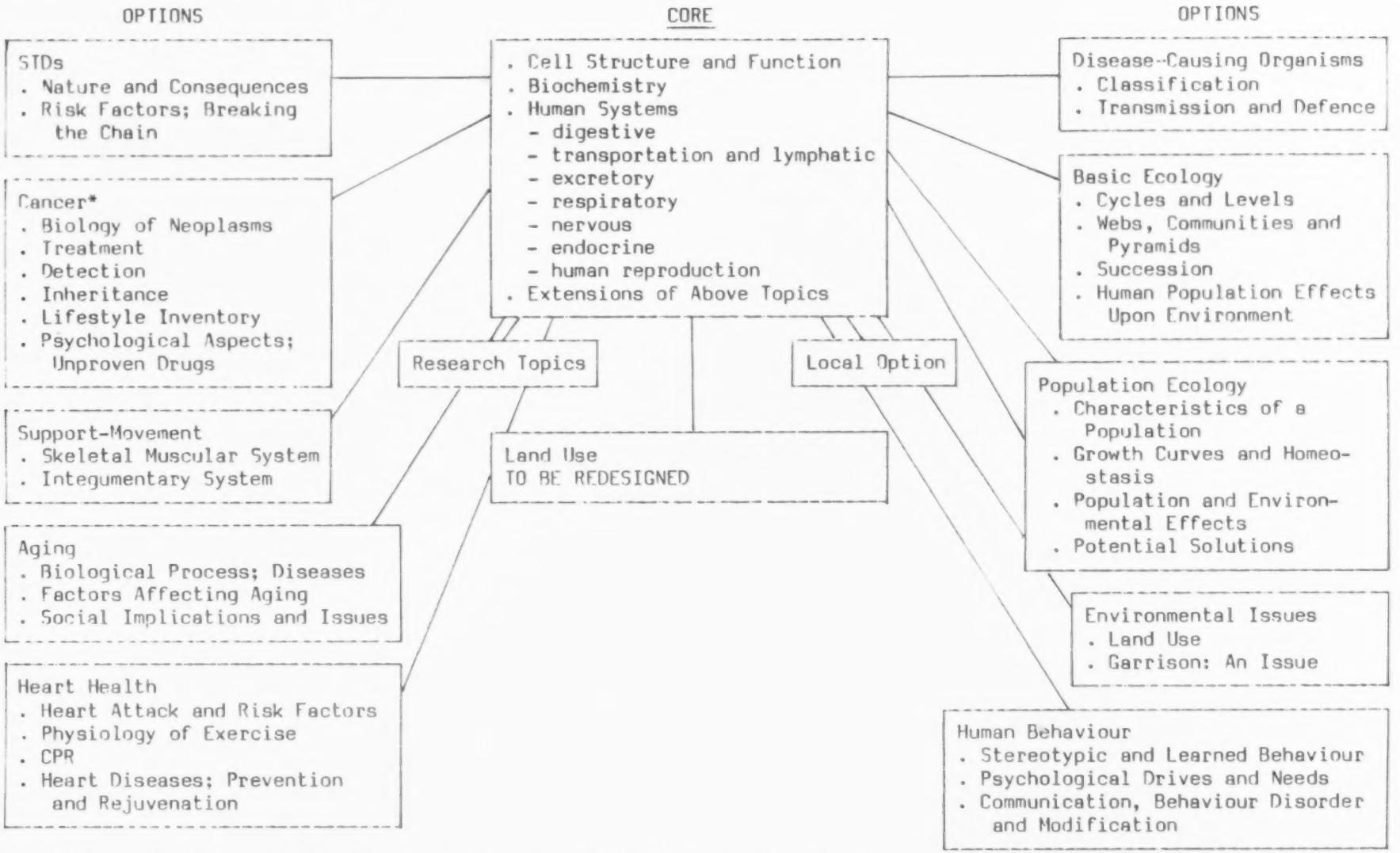
Flexibility to meet the varying needs and abilities of high school students is provided in the option units. From the options, two must be chosen for completion. The units vary in complexity and in their emphases upon different aspects of the science, technology and society goal. Modules or other kinds of materials have been suggested to support these units. The option units offer a variety of approaches and different levels of complexity. Schools can complete their own local option unit as long as it meets aspects of the science, technology and societal goals.

Relationship Between Biology 200, 300 and Biology 201, 301

Although some parallelism exists between core topics in Biology 200, 300 and Biology 201, 301, a number of fundamental differences between the courses do exist. The differences are:

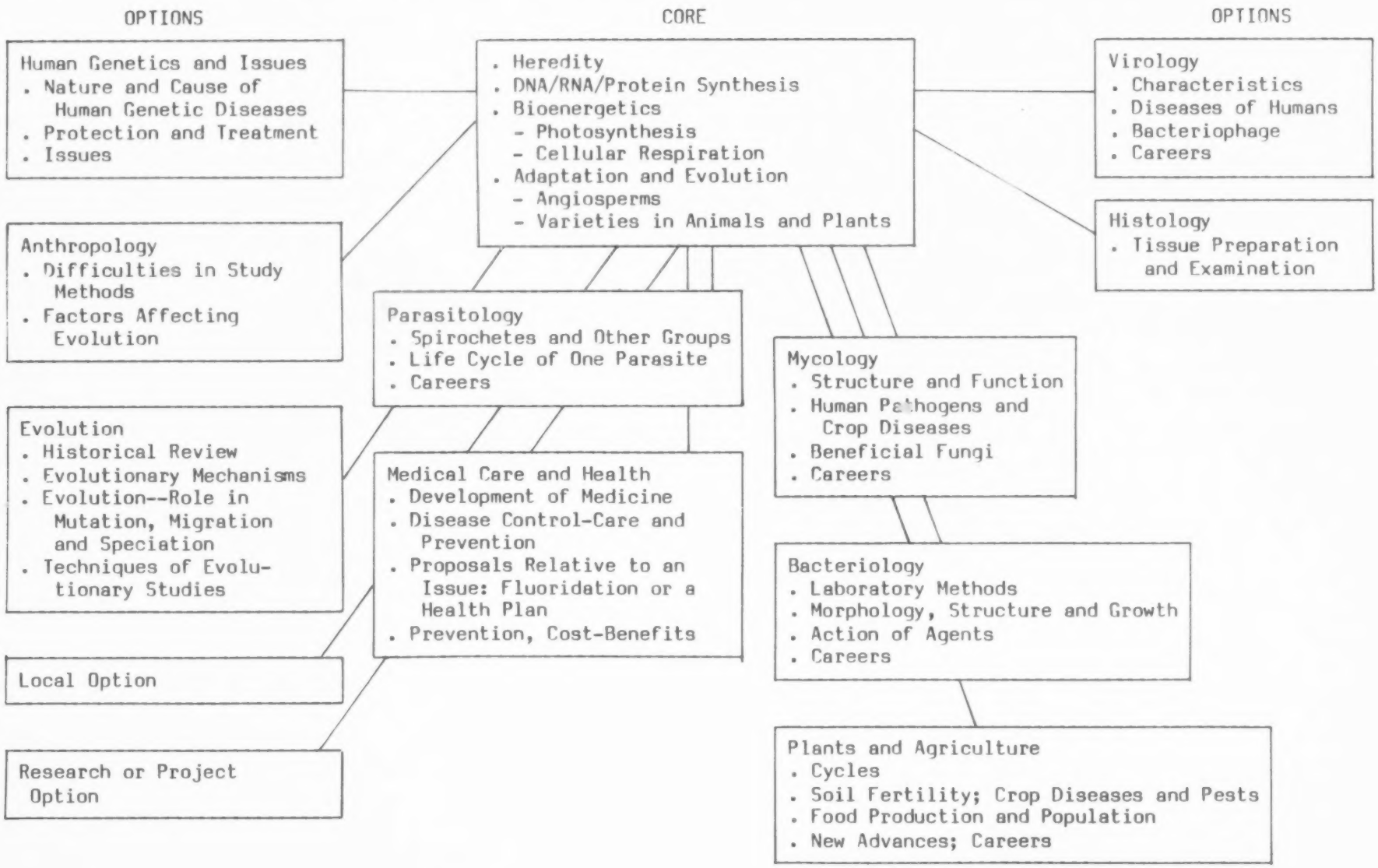
. The level of expectation for Biology 200, 300 is higher than it is for Biology 201, 301.
. Some core topics have been eliminated from the Biology 300 course to produce the 301 course. Bioenergetics has been eliminated and diversity can be attained by using either plants or animals. This provides a greater degree of choice among topics.
. Some of the more difficult options in Biology 200, 300 were removed and replaced with options such as Consumer Biology and Food Preservation to produce the 201, 301 course.

GENERAL TOPICAL DESIGN FOR BIOLOGY 200



*If this topic is chosen, teachers should determine the extent to which it may have been taken by students in Science 100 or 101.

GENERAL TOPICAL DESIGN FOR BIOLOGY 300



RELATIONSHIP BETWEEN MATERIALS AND CORE OR OPTIONS

TEXTUAL MATERIALS	BIOLOGY 200 OPTIONS											
	Core	STDs	Cancer	Support/ Movement	Aging	Heart Health	Disease Orgs.	Basic Ecology	Pop. Ecology	Envir. Issues	Human Behav.	Pro-ject
Core Texts												
1) Biology: The Science of Life*	•	•		•		•	•	•	•		•	
2) Biology of Ourselves**	•	•		•		•					•	
3) Addison-Wesley Biology*	•			•				•			•	
4) Biology and Human Concerns (Teacher Reference)	•				•	•		•	•	•	•	
Laboratory Manuals												
1) Laboratory Biology: Investigating Living Systems	•			•				•	•			
2) Addison-Wesley Biology Laboratory Manual	•							•	•			

*Textbook supports both Biology 200 and 300 core and some options.
**Supports Biology 200 only. Also useful for Biology 201.

In some cases, a variety of references are used. Refer to unit design for specific information.

TEXTUAL MATERIALS	BIOLOGY 200 OPTIONS											
	Core	STDs	Cancer	Support/ Movement	Aging	Heart Health	Disease Orgs.	Basic Ecology	Pop. Ecology	Envir. Issues	Human Behav.	Pro-ject
Texts or Modules Supporting Options												
1) The Wild Cells			*									
2) The Garrison Diversion (Kit)										*		
3) Wetlands Management Case Study										*		
4) Psychology: A Scientific Study of Human Behaviour (Teacher References)											*	
5) Biological Science: Interaction of Experiments and Ideas (Teacher Reference)											*	*
6) VD Handbook (Teacher Reference)	*											
Health Focus on You: Venereal Diseases--Sexually Transmitted Diseases	*											

In some cases, a variety of references are used. Refer to unit design for specific information.

TEXTUAL MATERIALS	BIOLOGY 200 OPTIONS											
	Core	STDs	Cancer	Support/ Movement	Aging	Heart Health	Disease Orgs.	Basic Ecology	Pop. Ecology	Envir. Issues	Human Behav.	Pro-ject
7) Readings on Aging and Death: Contemporary Perspectives (Teacher Reference)					*							
8) Health Focus on You: Aging, Dying and Death					*							

In some cases, a variety of references are used. Refer to unit design for specific information.

RELATIONSHIP BETWEEN MATERIALS AND CORE OR OPTIONS

TEXTUAL MATERIALS	BIOLOGY 300 OPTIONS											
	Core	Gen. & Issues	Anthr.	Evolution	Plants & Agric.	Virology	Histology	Parasit.	Mycol.	Bact.	Medical Care	Project
Core Texts												
1) Biology: The Science of Life*	*			*	*							
2) Biology of Ourselves							*	*				
3) Addison-Wesley Biology*	*											
4) Biology and Human Concerns (Teacher Reference)	*	*	*	*	*							
Laboratory Manuals												
1) Laboratory Biology: Investigating Living Systems	*			*					*			
2) Addison-Wesley Biology Laboratory Manual	*											

In some cases, a variety of references are used. Refer to unit design for specific information.

TEXTUAL MATERIALS	BIOLOGY 300 OPTIONS											
	Core	Gen. & Issues	Anthr.	Evolution	Plants & Agric.	Virology	Histology	Parasit.	Mycol.	Bact.	Medical Care	Project
Texts or Modules Supporting Options												
1) BSCS Biological Science: A Molecular Approach			*	*		*						
2) Microbiology and Pathology (fourth edition) and Microbiology Laboratory Manual and Workbook (seventh edition) (Teacher References)						*		*	*	*		
3) Science in Society (Teacher's Guide) and Medicine and Care or Diseases and the Doctor Simulation--Dental Health Project or Marimbian Health Service Project											*	

In some cases, a variety of references is used. Refer to unit design for specific information.

TEXTUAL MATERIALS	BIOLOGY 300 OPTIONS											
	Core	Gen. & Issues	Anthr.	Evolution	Plants & Agric.	Virology	Histology	Parasit.	Mycol.	Bact.	Medical Care	Project
4) The New Evolutionary Timetable (Teacher Reference)				•								
5) Science, Technology and Society (Teacher Reference) and Biomedical Technology		•										
OR												
Human Reproduction: Social and Technological Aspects												
6) Human Genetics		•								•		
7) Biological Science: Interaction of Experiments and Ideas												•

In some cases, a variety of references are used. Refer to unit design for specific information.

LABORATORY ACTIVITIES

Laboratory activities have an important place in any science program which attempts to reflect the nature of the discipline, including both process skills and concepts. A minimum of twenty laboratory experiments for Biology 200 and twenty-one for Biology 300 is required. Suggested laboratory activites in core are marked with an asterisk (*). This guide recommends a variety of activities from which teachers can choose. Other laboratory activities can be found in the laboratory manuals.

Although the Biology Committee has attempted to monitor the recommended experiments for safety, teachers should be guided by safety considerations in making their own choices.

Laboratory activities are designed to develop skills in observing, classifying, quantifying, formulating hypotheses, making operational definitions, controlling and manipulating variables, predicting, experimenting and communicating. In addition to these science process skills, there are some specific skills that students should develop in the laboratory:

LABORATORY SKILLS

The student should be able to:

1. demonstrate correct microscope techniques and appropriate care for the microscope;
2. read instruments accurately, e.g., spygmanometer, thermometer;
3. properly prepare and stain specimens for microscopy;
4. use correct oseptic techniques where required;
5. perform appropriate diagnostic testing
6. pipette any required amount of liquid, using proper techniques
7. operate a burner properly;
8. make solutions in the correct concentrations;
9. maintain a clean work environment, taking care that materials are disposed of in proper containers;
10. respect the purity of reagents (never laying a stopper directly on the bench and never transferring reagents back to their original containers, once handled)
11. exhibit appropriate use of dissecting equipment;
12. correctly handle and maintain living organisms.
13. use proper collecting and preserving techniques;
14. use correct techniques for the separation of pigments;
15. use proper techniques for the handling of live specimens.

MATHEMATICAL SKILLS

There are also some mathematical skills that students should develop in their labortory experience.

Students should be able to:

1. use:
   a. the four basic operational skills--addition, subtraction, multiplication, division;
   b. scientific notation 10^x;
   c. basic operations on scientific notation;
   d. percent calculations by volume and by weight;
   e. probability, ratio/proportion;
   f. statistical procedures in interpreting data.

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2. construct a properly labelled and drawn graph from given experimental data;
3. read and interpret data, given graphs (basic scale, non-logarithmic) and tables of data;
4. develop an ordered table of data;
5. determine the results of calculations only to the precision warranted by the given data.

SUPPORT MATERIALS

The purchase of a great number of new materials is not necessary during the initial stages of adoption. However, most texts currently used will be inadequate in the areas of human anatomy and additional laboratory activities. New textual, modular, or teacher-support materials will be required for further implementation of the program. The choice of materials is dependent upon the choices made in regard to options, the desired teaching approach to be emphasized and the depth of content to be presented. For example, a school may wish to use Biology of Ourselves: A Study of Human Biology as a new text for grade eleven and temporarily retain the old text (BSCS Blue Version) for Biology 300. Biology of Ourselves could be used to teach the core for Biology 200 and the options entitled Heart Health, Support and Movement, and Disease-Causing Organisms. BSCS Blue Version could be used to teach the core for Biology 300 and the options entitled Evolution and Anthropology. An alternate scheme would be to choose Biology: The Science of Life for developing the majority of core in Biology 200 and 300 and options such as Basic Ecology, Population Ecology, and STDs in grade eleven, and Origins, Plants and Agriculture and Mycology in grade twelve.

Since it is possible to teach some optional topics by using teacher resource or library materials only (e.g., Cancer, Aging, Histology and a variety of other possibilities or combinations), the correlation charts of materials and topics on pages 47-52 of this guide can be used for reference. During the first year of adoption of the new program, teachers should familiarize themselves with various possibilities. Single copies of materials can be obtained and tested at that time. In addition, a limited number of samples will be available in the Manitoba Education Library.

As the correlation charts of materials and topics indicates, there are a number of other possible combinations. Teachers should become familiar with these possibilities during the first stage of implementation. Single copies of materials can be obtained and tested at that time. A limited number of samples is available in the Manitoba Education Library.

EVALUATION

Evaluation of student achievement and program effectiveness must be an integral, ongoing part of the teaching-learning process. Evaluation should provide information regarding:

1. Diagnosis and remediation. The purpose of diagnosis is to identify a student's strengths and weaknesses. Problems may then be identified and appropriate remediation can be provided by the teacher.

2. Student achievement of curriculum goals. This is an integral part of a developmental program. Because growth is continuous, evaluation must also be continuous.

3. Learning strategies. Evaluation results should be used to judge the effectiveness of the instructional process (program of experiences, materials of instruction and strategies of teaching).

4. Curriculum modification. Modifications should be ongoing. Therefore, continuing feedback from the schools regarding the appropriateness of the objectives and the degree of implementation of the current program is essential.

Accurate and objective data are necessary to provide a sound basis for evaluation. Data for evaluation may be obtained from sources such as term and final examinations, assignments, activity checklists, oral tests for students with learning problems, laboratory specimen tests, projects, class participation and laboratory activities.

Tests are a vital source of data for evaluation. To ensure that individual differences in aptitudes and interests are reflected in the results of testing, teachers should use a variety of testing procedures. Certain skills and knowledge are best measured by short-answer, multiple choice and labelling questions. Test questions that require the interpretation of data, the drawing of inferences or the identification of relevant variables can be devised.

Written reports are another source of data for evaluating communication skills and the students' abilities in research, interpretation and evaluation of printed information. Social and psychomotor skills may be evaluated by observing student activity in the laboratory.[1]

WOMEN AND SCIENCE

> A common sense approach would suggest that the student who finds science interesting, who has been encouraged to explore and feel confident with the material, and who perceives scientific endeavour to be compatible with their other life expectations, will be motivated to study these subjects.[2]

The study of biology has traditionally appealed to women. In the past, the position of women in biology has usually been that of helper. Now, however, women are becoming more active; for example, many women are now studying such biological sciences as medicine, genetics and veterinary science.

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[1] Additional sources of information about evaluation can be found in William D. Hedges, Testing and Evaluation in the Secondary School (Belmont, CA: Wadsworth, 1966), in Robert B. Sund and Anthony J. Richard, Behavioral Objectives and Evaluational Measures: Science and Mathematics (Columbus, OH: Charles E. Merrill, 1972), Peter Harris et al., Objectives and Sample Investigtions for Alberta Biology Courses (Edmonton: Science Council of Alberta Teachers' Association, 1974), available from Manitoba Department of Education Library.

[2] Janet Ferguson, ed., Who Turns the Wheel? (Ottawa, ON: Science Council of Canada, 1981), p. 69.

RESEARCH FINDINGS

Two factors that seem to be most strongly related to choosing a profession in science or engineering are academic achievement and adult attitude towards nontraditional career choices. Although research suggests that the separation of girls from science begins early in life and that sociocultural factors play a major role in fostering observed sex-related differences in achievement in science, a number of findings are important to helping adolescents to develop a greater interest and better achievement in science. Some of the factors which can be considered relevant to the achievement in science among girls are:

- "While the evidence suggests that girls may be better at learning and solving problems in a verbal medium than they are in a visual medium, many boys fall into this category as well. . . . The sex differences in ability are too small to be used as a key factor in selecting an educational strategy."[3]
- ". . . typical science-related character traits . . . are also part of masculine competency."[4]
- "Girls in single-sex schools study physics, chemistry and mathematics more often than do coeducated girls."
- "The degree of social reinforcement (approval) offered to the student by the teacher may be more important than the sex of the teacher."[5]
- "While seeming contradictory, it appears necessary to introduce positive reinforcement for nonstereotyped behaviours for both boys and girls. This means girls will benefit greatly from a recognition of success in science- or technology-based activities."[6]

[3] Ibid, p. 58.

[4] A. Kelly, "Sex Differences in Science Achievement," The Missing Half, Girls and Science (Manchester, U.K.: Manchester University Press, 1980).

[5] D.S. Monatelli and K.T. Hill, "Children's Achievement Expectations and Performance as a Function of Two Consecutive Reinforcement Experiences, Sex of Subject, and Sex of Experimenter," Journal of Personality and Social Psychology, vol. 13 (1969), p. 115.

CURRICULUM IMPLICATIONS AND STRATEGIES

Although efforts to instil interest and develop confidence among girls in science must begin early in elementary school, a number of approaches can be used in secondary school courses to help them maintain interest and develop academic achievement.

The development of content relevance is one method of supporting the interest of women in the biological sciences. The design of the new biology program attempts to provide relevance by providing choices among a variety of options, by emphasizing the potential effect of science-technology on the individual and by developing the practical aspects of the study of biology. For example, a study of some aspects of biotechnology such as genetic screening or engineering can be examined in terms of biological content and/or the implications of these technologies for the individual. Emphasis upon the practical aspects of heart health or plants and agriculture can be made more compatible with a student's life expectations than an accumulation of abstract ideas can.

The development of general problem-solving skills by cooperative action is important. These skills can be taught effectively in the laboratory. Encouraging girls to participate in all aspects of laboratory activities as equal partners is important. There is some evidence to indicate that the use of single-sex groups during initial stages and then changing to mixed groups in later stages is a useful strategy to avoid

[6] Ferguson, Who Turns the Wheel?, p. 73.

male-dominance/female-submission situations.[7] Strategy games and simulations are also useful for developing problem-solving skills in a more generalized context, e.g., science and social science areas.

Demonstrating alternative options for women by showing the connection between mathematics and science and careers or showing examples of women working at predominantly male jobs is also useful.

SPECIAL NEEDS STUDENTS

It is not likely that there will be students in either Biology 200 or 300 whose needs will require any substantial modification of the program. Flexibility has been designed into the course to allow for the variation in students' abilities and needs. Teachers can take advantage of the variety of teaching materials and strategies suggested in this guide.

TALENTED OR GIFTED STUDENTS

The Biology 200 and 300 outline identifies the minimum program for students. Students who are gifted or talented in science are likely to meet the course objectives in less time than others do and may exhibit one or more of the following characteristics: 1) outstanding performance in most academic subjects; 2) prolific reading and the ability to understand scientific textbooks and articles; 3) preference for independent work with little teacher direction; 4) curiosity about abstract concepts; and 5) willingness to assume responsibility.

Teachers of students gifted in science are faced with the challenge of enriching the program with stimulating and worthwhile activities. Suggestions for enrichment follow.

Stimulating Interest

- Provide a wide variety of materials and resources, such as the Science Teacher or Scientific American and other professional journals or magazines.
- Encourage reading in biology.
- Encourage the pursuit of projects of special interest to the student.
- Use science clubs to maximum advantage.
- Organize seminars at which students can present papers and special projects for ultimate submission to journals and newspapers.
- Encourage peer tutoring.
- Encourage participation in science fairs.

Providing Opportunity for Meaningful Activity

- Enrich the program.
- Provide independent activities.
- Encourage entry in biology contests and competitions.
- Promote computer use in the study of biology.
- Encourage students to apply their biology to fields such as engineering, environmental science and medicine.

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[7] Joan Skolnick et al., How to Encourage Girls in Math and Science (Englewood Cliffs, NJ: Prentice-Hall Inc., 1982), p. 55.

Developing Additional Skills

- Provide higher-level activities in problem solving, research reading and writing skills than those required for regular programs. For example, BSCS Biological Science: Interaction of Experiments and Labs (New Jersey: Prentice-Hall Inc., 1977), is an excellent resource which contains a description of activities.
- Emphasize the development of students' manipulative skills.

LABORATORY SAFETY

There is a safe way to perform all laboratory work. Just as defensive driving can prevent accidents on the road, adequate planning and understanding can prevent injury in the laboratory. "What should happen if. . .?" should be a question that guides the preparation and performance of all experiments. Answering this question requires an understanding of the hazards associated with the materials involved. Thus, a knowledge of the nature and toxicity of materials being studied dictates the precautions to be taken. Such information might well form an introductory section to all written laboratory procedures.

The practice of safety in the biological laboratory requires: 1) the desire on the part of the individual to protect not only him- or herself but others as well; and 2) an understanding of the need to follow a set of rules. The former can be termed "safety morale," the latter "safety logic." Both are essential parts of accident prevention. Rules are usually established by the laboratory supervisor. However, communicating these rules should be accomplished through discussion with all biology students.

The prevention of accidents in a laboratory is the responsibility of every individual who enters it. For the teacher, there is a special responsibility of reducing the opportunities for incidents that could give rise to injury. In this context, laboratory safety is a positive component of science teaching, and the importance of careful planning should be stressed throughout the program. As a result of this part of the biology program, students should develop safety-conscious attitudes and behaviour. Since students tend to lack the instinctive feeling for investigative work that comes from the long-term familiarity with the laboratory, they must be taught how to handle materials which are potentially harmful to them.

SAFETY RULES

There should be only a limited number of rules for the laboratory, but the rules must be rigidly and impartially enforced. Willful non-compliance should result in dismissal or suspension from the laboratory.

There are many specific "dos" and "don'ts" related to specific situations and activities. For further guidance, teachers are referred to Safety in Science for Manitoba Science Teachers (1973) and Safety in Science (1982).[8] For additional information, teachers are also referred to the bibliography in this guide.

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[8] Copies were distributed to schools at the time of publication. Additional copies of Safety in Science (1982) are available from Curriculum Development and Implementation, Manitoba Education.

SAFE FACILITIES

The laboratory environment should be equipped with the appropriate safety devices and materials.

SAFETY RESPONSIBILITY

Each individual is responsible for performing his or her job safely. Untrained students or outsiders should not be permitted to work with materials except under adequate supervision. An instructor should be in the laboratory for the entire laboratory period.

Every teacher should:

1. Set a good example by:
   a) observing all rules and recommendations;
   b) wearing protective equipment where recommended;
   c) being enthusiastic about safety.
2. Be alert for unsafe conditions.
3. Take prompt corrective action for unsafe conditions.
4. Maintain discipline and enforce rules.
5. Prohibit the use of laboratory glassware for food or beverages--a dangerous practice.
6. Assume responsibility for visitors and require that they follow the same rules as students and other laboratory workers.
7. Carefully review all laboratory experiments for possible safety problems before the experiments are assigned to students.
8. Maintain a file of publications on laboratory safety, and make it readily available to students, visitors, and others using the laboratory.

School science laboratories can be as safe a place to teach and learn as any other place in the school. This will occur only through the constant vigilance of teachers and students alike.

SAFETY NOTES IN THE GUIDE

In the Activities Section of the unit design charts in this guide, precautions are given for any recommended experiments that may require particular care in handling. It is suggested that the teacher refer to these cautionary notes often. In addition, the Biology section of Safety in Science (1982), available from the Manitoba Education, provides additional information about such potential areas of study as sterilization techniques for bacteria and testing human biological fluids.

ISSUES AND DECISION MAKING IN A BIOLOGY CURRICULULM

RATIONALE

> What is a serious defect, warranting non-existence? . . . Ought we to develop the technology to control our own evolution? Our students raise these questions and we, as teachers, ponder our responses.[9]

Biology teachers should attempt to foster the development of students who are biologically literate by imparting knowledge about biology and scientific methods.

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[9] Thomas R. Mertens and Jon R. Hendrix, "Responsible Decision Making: A Tool for Developing Biological Literacy," The American Biology Teacher, vol. 44, no. 3 (March 1983), p. 148.

the increasing effect of science and technology upon the choices available to individuals and society implies that biological literacy should also include the ability to apply biological knowledge to personal and societal questions, problems or issues.

If the definition of biological literacy is to include an understanding of the relationship between biology and technology and their effect upon the individual, then students will have to be provided with opportunities to develop concepts and skills which may not be a part of the usual biology program. For example, students will have to be aware of the interdependency between science and technology, the limitations of science and technology, and the roles of science and technology in increasing human material comfort. They should be able to examine and propose alternate solutions to science-technological-societal issues, the limits of related knowledge and the trade-offs involved. In order to examine alternatives, students will have to be aware of the limitations of data, the significant elements of an issue, and be able to evaluate available information and alternatives. A number of approaches such as simulations, research reports and debates can be used in the development of these objectives.

ELEMENTS OF AN ISSUES APPROACH

In order to examine an issue, a student needs to have an understanding of the relevant scientific-technological background to the question; the student also needs to have developed skills in outlining an issue and making decisions, and to understand the relationship of values to making decisions.

DECISION MAKING

Decision making may be broken down into four major stages. They are:

a) Confrontation with the need for choice--an occasion for decision.
   - define the issue

b) Determination of important values or goals affecting the decision.
   - determine: why the issue?
   - identify the goals to be achieved and the resulting consequences
   - examine beliefs in the good, the right, the valuable or the important
   - list higher references
   - what results we want from our decisions

c) Identification of a range of alternative courses of action.
   - ask what actions can be taken to solve the problem
   - ask which actions best reflect the values and goals set out

d) Gauging the positive and negative consequences of these various courses of action.
   - identify the plus and minus effects of various choices in terms of tradeoffs or costs
   - choose the option that gives the greatest award for the least cost

Outcomes of the process can include such benefits as:

(a) Students are more strongly motivated if they make decisions themselves.

(b) Students learn to consider and analyze alternatives.

(c) Students learn to make wiser choices through practice and an occasional unwise decision.

(d) Students learn to identify and make adjustments for individual strengths and weaknesses.

(e) Students learn to recognize that there are more ways than one to satisfy an objective set.

VALUES AND THE VALUING PROCESS

In ethical decision making, different values are composed, and in weighing these values, a student can reach an ethical judgement.

CHARACTERISTICS OF ETHICS

(a) deals with the good (ethical decisions are designed to promote the good);

(b) asks and tries to answer questions regarding what action is correct;

(c) decision making based on reason;

(d) decision making based on weighing different values.

CHARACTERISTICS OF VALUES

(a) imply preference;

(b) indicate what is judged to be good;

(c) are supported by rational justifications;

(d) specify a course of action;

(e) imply strong feelings or intense attitude.

STEPS IN THE VALUING PROCESS

(a) Choosing — The person must be able to select what he/she feels is good or bad freely from a series of alternatives and after thoughtful consideration of the consequence of each alternative.

(b) Prizing — After the person makes a selection, he/she must be satisfied with it. He/she may demonstrate satisfaction by publicly affirming the choice.

(c) Acting — The person must act upon the choice with some repetition.

A POTENTIAL MODEL[10]

The following model outlines a sequence of stages for dealing with issues. Some current issues which could be examined with profit are euthanasia, cryogenics, DNA research, population control and genetic engineering. In view of the changes that occur in science-technology, the kinds of issues currently of concern could change.

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[10] Thomas R. Mertens and Jon R. Hendrix, "Responsible Decision Making: A Tool for Developing Biological Literacy," The American Biology Teacher, vol. 44, no. 3 (March 1983), p. 149.

1. Identify Problem

   (a) write a short paragraph explaining why you have identified your problem as a value/ethical problem;

   (b) identify and list five personal values that are expressed in your statement;

   (c) rank these values from 1 (most important to you) to 5 (least important to you).

2. List alternative solutions to problem (minimum five).

3. Rank solutions by personal value preference.

4. List values or principles you hold that force you to rank a solution as a #1 choice.

5. Repeat step 4 using the solution you ranked as last.

6. List consequences to various systems (e.g., family, schools, medical and legal professions, etc.) if your #1 ranked solution were implemented worldwide.

7. Assess each consequence through your "value screen" as being good (+) or bad (-).

8. Tally your assessment for 7 and ask yourself, "Are there any 'bad' consequences that overrule 'good' consequences?"

9. Screen your #1 choice through your ethical principles: if there is agreement, continue to step 10; if there is conflict, select alternate solution, e.g., #2 or modify #1 and repeat steps 3 to 9.

10. List reasons why others might not agree with your solution.

11. Place "conviction" assessment on your solution: confident 1 2 3 4 5 no confidence.

SOME APPROACHES

Some general considerations that teachers should make in developing or leading the examination of issues by students are:

1. Allowing students to learn through direct confrontation with facts, ideas or issues. Students should have the opportunity to learn as active participants, not as passive observers.

2. Helping students understand that more than just information is needed to resolve an issue. Through experience with issues, students will have the opportunity to develop greater tolerance and to refine their abilities to deal with complicated social issues.

3. Identifying the values (personal and social) that are inherent in the issue under consideration. What does each value mean? What are the priorities of the values? How are the various values in conflict?

4. Encouraging students to reach their own decisions, not merely to accept the unquestioned decisions of others.

   (a) adapting presentation to the students' needs
   (b) encouraging participation
   (c) using small group discussion
   (d) remaining neutral

Some general methods that can be used are:

1. Discussion

   Five steps in conducting an issues discussion are as follows:

   (a) presentation of the issue
   (b) selection of alternative positions
   (c) small group discussion
   (d) class discussion
   (e) summary and closing of discussion

2. Research Report Analysis

   (a) What was the problem being researched?
   (b) Is the problem one of significance and importance?
   (c) What facts were presented?
   (d) What assumptions were made?
   (e) What familiar techniques were employed in the research?
   (f) What new techniques were introduced?
   (g) Can the experiments performed be repeated with the same results?
   (h) What were the conclusions drawn by the experimenter?
   (i) What questions were left unanswered?
   (j) Are there any contradictions in the view of previously or current accepted ideas?
   (k) Are there any ambiguities in the line of reasoning being presented?
   (l) What generalizations can be made on the basis of the study?
   (m) What effect will this study have on humans and on society?

Other approaches include debates, placing an issue on trial and interviews. In addition, since the development of this approach requires the examination of additional information and time to organize and polish, additional sources of information are provided as a starting point for further development.

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CONTROVERSIAL ISSUES AND SCIENCE PROGRAMS

NATURE OF SCIENCE AND SCIENCE CURRICULULM

Science is a system of learning about the universe through data collected by observation and experimentation. As data are collected, theories are advanced to explain and account for the observations. The test of a theory in science is its ability to:

1. explain what has been observed;
2. predict what has not yet been observed;
3. be tested by further experimentation and to be modified as required by the acquisition of new data.

The design of provincial science curricula and their supporting documents and texts must reflect the nature and concepts of science as understood by the scientific theories or models such as the atomic or evolution theories will provide the framework for science curricula.

CONTROVERSIAL ISSUES--A GENERAL POLICY

Issues, as a result of curriculum revisions, can exist locally or in broader jurisdictions. In order to aid local jurisdictions in approaching controversial issues in schools, guidelines have been published in the Administrative Handbook under the heading "7.00 The Teaching of Controversial Issues." The guidelines are as follows:

"The current cycle of curriculum revision, inevitably, is resulting in the development of programs which include issues that may be deemed sensitive by some groups or individuals within the community. These issues may be included among a program's objectives and are part of core program requirements. Alternatively, they may be found among the various instructional strategies and/or materials suggested to support the teaching of the program. Here, their utilization is entirely a matter of local discretion. The following statement provides a Department of Education policy for the handling of both situations.

"The basic principle of education in Manitoba is that, through the school program students should demonstrate an increasing ability to make informed and rationale decisions through the development of the skills of inquiry, analysis, synthesis, and evaluation; decisions that are based on a personal value system which recognizes both the priorities of their society and the integrity of the individual. To this end, therefore, students should be provided with learning experiences in the selection and organization of information that include alternative points of view where appropriate; relate the needs, ability, and level of maturity of students to the expectations outlined in the curriculum guide; and respect parental concerns. Students in Manitoba classrooms should not be ridiculed or embarassed for positions which they hold on any issue and are entitled to sensitivity on the part of teachers, students, and other participants in dealing with such issue.

"Further, Manitoba Education recommends to local school division boards that, following consultation with school administrators, teachers, students, and parents, they establish local policies for the identification and treatment of controversial issues in their classrooms, including the identification of issues, selection and utilization of materials, and teaching strategies."

biology 200 (core)

UNIT DESIGN CHARTS FOR BIOLOGY 200 CORE

UNIT I: TITLE: Cell Structure and Function

RATIONALE: The cell is the basic unit of life. A basic understanding of cell structure, growth and reproduction is necessary for students before they can study the growth and development of the human organism. This unit covers these topics as well as the progressive development of the science of cytology and the development of the microscope.*

SECONDARY REFERENCES:

1. BSCS Blue Version. Biological Science: A Molecular Approach. Boulder, CO: D.C. Heath and Co., 1980.
2. BSCS Yellow Version. Biological Science: An Inquiry Into Life. New York: Harcourt Brace Jovanovich, 1980.
3. Evans, William F. Anatomy and Physiology. Third edition. New Jersey: Prentice-Hall Inc., 1983.

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1. Purtilo, David T. A Survey of Human Diseases. Don Mills, ON: Addison-Wesley Publishing Co., 1980.
2. Andrews, W.A., et al. Biological Science: An Introductory Study. Scarborough, ON: Prentice-Hall of Canada Ltd., 1980.
3. Volpe, Peter E. Biology and Human Concerns. Third edition. Dubuque, IA: Wm. C. Brown Co., 1983.

*Teachers may wish to integrate the study of all membrane transport with the study of the kidney in the unit, Excretion, or the unit, Digestion. Objectives in core units represent minimums.

4. Cavese, Joseph A. "Analogue for the Cell." American Biology Teacher, vol. 38, no. 2 (February 1976).

5. Mathis, Phillip M. "The Use of Manipulative Models in Teaching Mitosis and Meiosis." American Biology Teacher, vol. 40, no. 9 (December 1978).

6. Hawk, J.A. "Demonstrating Mitosis and Meiosis." American Biology Teacher, vol. 38, no. 2 (February 1976).

7. Garcia, D. "The Night Before Christmas in a Cell." American Biology Teacher, vol. 37, no. 9 (December 1975).

8. _____. "Special Issues on Careers, Parts I and II." American Biology Teacher, vol. 40, nos. 7 and 4 (March and April 1978).

9. Ford, B.J. "Found: The Last Treasure of Anton Leeuwenhoek." Science Digest, vol. 90, no. 3 (March 1982).

10. Deave, James. "Modelling Limits to Cell Size." American Biology Teacher, vol. 40, no. 80 (November 1978).

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
The student should be able to:		
1.0 Identify the parts and function of a compound microscope. 1.1 Demonstrate correct use of a compound microscope. 1.2 Compare the capabilities of the light and electron microscope. 1.3 Describe how advancing technology has contributed to the development of the understanding of cell structures and function.	* 1.0-1.3 Identify the parts and functions of the compound microscope. Demonstrate the following skills: - wet mount - hanging drop - oil immersion - immobilization of protist - measuring an object under a microscope - staining a biological sample - calculations of magnifications and field of diameters Discuss the terms: - parfocal - resolving power	Laboratory Biology: Investigating Living Systems: Experiment 2, "The Use of the Light Microscope"; Experiment 3, "Techniques for Better Microscope Use." Addison-Wesley Biology: Laboratory Manual: Experiment 3, "The Compound Microscope"; Experiment 4, "Better Use of the Compound Microscope." Addison-Wesley Biology: Chapter 3, "The Cell: Basic Unit of Life."
2.0 Identify the following cell organelles using a light microscope and describe their function: - nucleoli - chromosomes - vacuoles - chloroplasts - cell wall - cell membrane	* 2.0-2.3 View prepared slides of cells. Read "An Analogue of a Cell" and discuss the relationship among cell parts and function and corporate structure and function.	2.0-2.3 Biology of Ourselves: Chapter 1, "Knowledge of the Human Body"; Activity 1, "Investigating the Structure and Function of Cells"; Activity 2, "Observing Human Cheek Cells." Addison-Wesley Biology: Chapter 3, "The Cell: Basic Unit of Life."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
2.1 Identify the structures as they appear in an electron micrograph and describe their functions: - ER mitochondria - pinocytic infolding - lysosomes - centriole - Golgi body - endoplastic reticulum		Laboratory Biology: Investigating Living Systems: Chapter 10, "The Basic Unit of Life" (Part 1) and "The Basic Unit of Life" (Part 2). "Analogue for the Cell," American Biology Teacher. Addison-Wesley Biology: Chapter 3, "The Cell: Basic Unit of Life."
2.2 Contrast the components of a plant and animal cell.		Addison-Wesley Biology: Chapter 15, "Reproduction of Molecules and Cells."
2.3 Identify and describe variations among different types of human cells.	Observe slides of mammalian tissues.	
3.0 Describe the process of mitosis.	Demonstrate mitosis. BSCS film loop, "Mitosis." The development should be limited to mitosis. DNA replication should be delayed to core in Biology 300. Emphasis should be on the outcomes of the process rather than on details.	"The Use of Manipulative Models in Teaching Mitosis and Meiosis," American Biology Teacher. "Demonstrating Mitosis and Meiosis," American Biology Teacher. "The Night Before Christmas in a Cell," American Biology Teacher.

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
3.1 Describe the factors that limit cell size.	Discuss surface area to volume ratio using various models.	Addison-Wesley Biology: Laboratory Manual: Experiment 22, "Cell Size--Is Bigger Better?" Biological Science: A Molecular Approach: Lab 10A, "What Is the Relationship Between Diffusion and Cell Size." Biological Science: An Inquiry Into Life: Chapter 3, "Cell Size." "Modelling Limits to Cell Size," American Biology Teacher.
4.0 Describe the structure of a cell membrane.		Biology of Ourselves: Chapter 1, "Knowledge of the Human Body."
4.1 Differentiate between the terms permeable, selectively permeable, impermeable.	Demonstrate the process of diffusion, osmosis, dialysis, active transport. Teachers may wish to attempt the laboratory activity, "Cell Membranes and Permeability" from Laboratory Biology: Investigating Living Systems or a similar activity from other laboratory texts.	Laboratory Biology: Investigating Living Systems: Lab 13, "Cell Membranes and Permeability"; Lab 12, "Normal and Plasmolyzed Cells." Addison-Wesley Biology: Laboratory Manual: Experiment 28, "Osmosis"; Experiment 29, "Movement of Matter Across a Cell Membrane." Addison-Wesley Biology: Chapter 3, "The Cell: Basic Unit of Life." "Special Issues on Careers, Parts I and II," American Biology Teacher.
4.2 Describe the processes whereby materials are transferred across a membrane.		

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
EXTENSIONS		
Cell Theory		
The student should be able to:		
1.0 State the cell theory.		Addison-Wesley Biology: Chapter 3, "The Cell: Basic Unit of Life."
2.0 Relate the contribution of the following scholars to the development of the cell theory: - Leeuwenhoek - Hooke - Schleiden - Schwann - Virchow - Ruska - Robert Brown	Do library research; construct a simple microscope.	Biological Science: A Molecular Approach: Chapter 10, "The Cell Theory." "Found: The Last Treasure of Anton Leeuwenhoek," Science Digest.
Levels of Organization		
The student should be able to:		
1.0 Describe the various levels of structural organization of the body.	Examine prepared slides of tissues and organs.	Biology of Ourselves: Chapter 2, "Tissues and Organs."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
		Biology: The Science of Life: Chapter 30, "The Human Body, Its Organs, Systems and Tissues." Addison-Wesley Biology: Chapter 3, "The Cell: Basic Unit of Life."
Careers The student should be able to: 1.0 Identify career responsibilities in cytology and histology.	Organize a tour to a cytology lab. Analyze literature pertaining to careers.	"Special Issues on Careers, Part I and II," American Biology Teacher.

UNIT II: TITLE: Biochemistry TIME: 5 hours (core)

RATIONALE: Life is often considered a series of chemical reactions. An understanding of basic biochemistry is necessary for an understanding of digestion and respiration, and so tht students can be aware of the need for good nutritional habits. This unit covers the basic theory of biochemistry and introduces the chemistry of carbohydrates, proteins, lipids and enzymes.

NOTE: Teachers may find it advantageous to integrate this unit with Unit III, Digestion.

TEACHER REFERENCE:

1. Gordon, Janet E. and Robert A. Richardson. Chemistry of the Body. Toronto, ON: John Wiley and Sons, 1985.

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
The student should be able to:		
1.0 Draw a simple Bohr atom diagram given the atomic number and mass.	Use the Bohr atom model to diagram the structures of hydrogen, carbon, nitrogen and oxygen.	Biology: The Science of Life: Chapter 7, "A Little Chemistry."
1.1 Define isotopes.	Introduce the use of isotopes in biology; e.g., as tracers.	Addison-Wesley Biology: Chapter 4, "The Molecular Machinery of the Cell."
1.2 Diagram the formation of an ionic bond between two atoms.	Explain the formation of sodium chloride in terms of ionic bonding.	Addison-Wesley Biology: Laboratory Manual: Experiment 13, "Measuring pH."
1.3 Explain pH in terms of the pH scale and the importance of pH to biological events.	Explain the role of ionization of water, acid and bases in the production of pH. Do a demonstration that uses pH indicators or pH meters to measure the pH of a variety of solutions such as saliva, fruit juices, urine,	Biological Science: A Molecular Approach (Fourth edition): Lab 4-B, "What Are the Acid and Base Characteristics of Some Common Biological Materials?"

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
	blood, milk (fresh and sour), carbonated beverages.	
1.4 Diagram the formation of covalent bonds between atoms.	Explain, using the Bohr model, the formation of ammonia, carbon dioxide, water. Use molecular model kits to demonstrate covalent bonding and spatial arrangements of atoms.	
1.5 Write and interpret simple chemical formulae and reactions given the symbols and valencies of the elements involved.	Explain reactions such as $H_2O + CO_2 \longrightarrow H_2CO_3$.	
NOTE: Some or all of the following biochemistry labs can be integrated with the unit on digestion.		
2.0 Write the empirical formula for carbohydrates (CH_2O).	Do a lab on the identification of carbohydrates.	Addison-Wesley Biology: Chapter 4, "The Molecular Machinery of the Cell."
2.1 Draw the structural formula of a glucose molecule.		2.0-2.3 Laboratory Biology: Investigating Living Systems: Experiment 6, "Carbohydrates: Chemistry and Identification."
2.2 Describe the relationship between mono-, di-, and polysaccharides.	Use models to illustrate the structure of glucose and complex carbohydrate molecules.	
2.3 Describe the uses of carbohydrates in the body.		Addison-Wesley Biology: Laboratory Manual: Experiment 18, "Nutrition."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
		Biology: The Science of Life: Chapter 8, "A Little More Chemistry: Foods." Biology of Ourselves: A Study of Human Biology: Chapter 14, "Nutrition."
3.0 Give a chemical definition of a protein.	Do a lab on the identification of proteins.	Laboratory Biology: Investigating Living Systems: Lab 7, "Proteins: Chemistry and Identification"; Lab 8, "Fats: Chemistry and Identification."
3.1 Identify the general structural formula of an amino acid.		
3.2 Identify a peptide bond in a protein chain.	Use molecular model kits to demonstrate peptide bonding and amino acid structure.	Biology of Ourselves: A Study of Human Biology: Chapter 14, "Nutrition." Biology: The Science of Life: Chapter 8, "A Little More Chemistry: Foods." Protein Synthesis--Boreal Scientific.

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
3.3 State the role and variability of dietary protein in the maintenance of homeostasis. 3.4 Describe the use of proteins in the body.	Discuss briefly the uses of proteins in regulation of body function, growth and repair.	
4.0 Give a chemical definition of a lipid.	Do a lab on the identification of lipids.	Laboratory Biology: Investigating Living Systems: Experiment 8, "Fats: Chemistry and Identification."
4.1 Identify a simple structural formula of a lipid 4.2 Describe the uses of lipids in the body.	Build a simple lipid using molecular model kits.	Biology of Ourselves: A Study of Human Biology: Chapter 14, "Nutrition." Biology: The Science of Life: Chapter 8, "A Little More Chemistry: Foods." Biology of Ourselves: A Study of Human Biology: Chapter 14, "Nutrition."
5.0 Give a simple definition of an enzyme.		

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
5.1 Describe the synthetic and degradative action of enzymes using the lock and key model.		Biology of Ourselves: A Study of Human Biology: Chapter 1, "Knowledge of the Human Body." Addison-Wesley Biology: Laboratory Manual: Experiment 14, "Enzyme Function." Biology: The Science of Life: Chapter 10, "Enzymes." Laboratory Biology: Investigating Living Systems: Lab 9, "Proof of Enzyme Action."
5.2 List the factors that affect enzyme action.	* Do a lab to illustrate the effect of temperature, pH, and concentration of enzyme action.	
5.3 Describe the use of enzymes in digestion.	See above activity.	

UNIT III: TITLE: Digestion TIME: 8-10 hours (core)

RATIONALE: Digestion is the process which allows for nourishment of living organisms: nutrients from the external environment are processed for cell utilization. This degradative process involves both physical and chemical breakdowns which occur at specific sites in the digestive tract. This unit covers discussion of the structure and function of the digestive components as well as the sites where physical and chemical breakdowns take place. It also covers the related topics of digestive malfunctions, diet and nutrition, obesity, the balanced diet and food additives.

TEACHER REFERENCE:

1. Garden, Janet E. and Robert A. Richardson. Chemistry of the Body. Toronto, ON: John Wiley and Sons, 1985.

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
The student should be able to:		
1.0 Identify the structure and function of the human digestive system.	Do a histological examination of digestive tissues.	Addison-Wesley Biology: Chapter 8, "Food Processing."
1.1 Describe methods of mechanical digestion.	Do fetal pig dissection.	Addison-Wesley Biology: Teacher Resource, Unit 1.
1.2 Identify the stages of physical breakdown of food through the digestive tract.		Laboratory Biology: Investigating Living Systems: Lab 62, "Digestive System of Frog and Human."
2.0 Describe the role of enzymes in human digestion and how specific enzymes operate at given digestion sites.	Demonstrate meat tenderizer. Do a few protein, fat and digestion labs.	Biology of Ourselves: A Study of Human Biology: Chapter 13, "The Digestive System."
		Biology of Ourselves: A Study of Human Biology: Chapter 13.

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
2.1 Identify the end products of digestion.		Addison-Wesley Biology: Laboratory Manual: Experiment 25, "Starch Digestion"; Experiment 26, "Protein Digestion."
2.2 Describe the metabolism and storage of lipids in the body.	Briefly explain how the liver processes lipids and forms and stores adipose tissue.	Laboratory Biology: Investigating Living Systems: Lab 9, "Proof of Enzyme Action"; Lab 27, "A Human Variation with Possible Adaptive Value"; Lab 7, "Protein: Chemistry and Identification"; Lab 8, "Fats: Chemistry and Identification."
2.3 Compare the effects of saturated and unsaturated fats on your health.	Give examples of fats that are saturated and unsaturated. Describe diets that are likely to have disproportionate amounts of saturated fats.	Biology of Ourselves: A Study of Human Biology: Activity 1, "Salivary Digestion of Starch"; Activity 2, "The Action of Lipase on Fats"; Activity 3, "Protein Digestion."
EXTENSIONS		
Digestive Malfunctions		
The student should be able to:		
1.0 List and describe the following human digestive malfunctions: - appendicitis - ulcers - enteritis		Biology of Ourselves: A Study of Human Biology: Chapter 13, "Case Study"; Chapter 13, "Hepatitis." Biology: The Science of Life: Chapter 31, "Some Disorders of the Digestive System."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
- hepatitis - constipation - dysentery - diarrhea - anorexia nervosa - bulimia		Biological Science: An Inquiry Into Life: Chapter 15. Addison-Wesley Biology: Chapter 5, "Food Production and Nutrition."
Diet and Nutrition The student should be able to: 1.0 Describe the role of vitamins and minerals in the human diet.		Biology of Ourselves: A Study of Human Biology: Chapter 15, "Case Study"; Chapter 13, "Vitamins."
Obesity The student should be able to: 1.0 Describe the cause(s) and treatment of obesity.		Biology of Ourselves: A Study of Human Biology: Chapter 15, "The Assessment of Body Size."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
Balanced Diets		
The student should be able to:		
1.0 Do a diet survey.		Biology of Ourselves: A Study of Human Biology: Chapter 14, "What Determines a Diet." Biology of Ourselves: A Study of Human Biology: Chapter 15, "Diet: Knowing What and How Much to Eat." Spenco AV (kit/cassette/slides), "Eating Your Way to the Grave." Computer Plum Diet. CONTACT: Computer Services, Manitoba Education Eating on the Run, Manitoba Education.
Food Additives		
The student should be able to:		
1.0 State the effects of various food additives.	Do a survey of contents of supermarket products. Do laboratory investigation of food additives on Rhisopus.	Biology Laboratory Manual (Scott, Foresman and Company): Activity 12B, "Challenge-Effect of Other Food Additives on Growth of Rhizopus."

UNIT IV: TITLE: Transportation TIME: 13-15 hours (core)

RATIONALE: This unit is divided into three major areas: the heart, the vessels and blood. Areas of discussion include: heart anatomy; pathways of blood flow; regulation of blood flow; the causes and treatment of vessel problems; blood disorders; the role of the circulatory system in homeostasis; and immunology. There is also a discussion of the lymphatic system and its importance in providing essential body defence.

SECONDARY REFERENCES:

1. BSCS Blue Version. Biological Science: A Molecular Approach. Boulder, CO: D.C. Heath and Co., 1980.

2. Fisher, Arthur. The Healthy Heart. Chicago, IL: Time-Life Books, 1981.

TEACHER REFERENCES:

1. Purtilo, David T. A Survey of Human Diseases. Don Mills, ON: Addison-Wesley Publishing Co., 1980.

2. Smith, Alice L. Microbiology and Pathology. Twelfth edition. St. Louis, MO: C.V. Mosby Company, 1980.

3. Scarrow, Hart R. Bodyworks: Your Human Biology. Toronto, ON: Globe/Modern Curriculum Press, 1979.

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
The student should be able to:		
1.0 Identify the anatomical components of the human heart and their related functions.	* Identify structures of the heart using specimens, models, diagrams or charts and describe the function of each structure.	Biology of Ourselves: A Study of Human Biology: Chapter 10, "Heart and Circulation of the Blood." Addison-Wesley Biology: Teacher Resource, Unit 2, "The Circulatory System." Addison-Wesley Biology: Chapter 9, "Transport." Biology: The Science of Life: Chapter 34, "The Cardiovascular Systems." Experiments in Modern Human Physiology: Experiment 20, "The Heart." Laboratory Biology: Investigating Living Systems: Lab 63, "Heart Anatomy."
1.1 Trace the pathway of blood flow through the human heart and associated vessels and organs.		Carolina Biological Supply, "Blood Flow."
1.2 Identify factors responsible for the regulation of the human heartbeat.	* 1.2-1.3 Do research on the factors that influence the heartbeat. Measure blood pressure. Demonstrate the	1.2-1.3 Addison-Wesley Biology: Laboratory Manual: Experiment 31, "The Human Heart Rate."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
	of exercise on pulse rate and blood pressure.	Bodyworks: Your Human Biology: Chapter 7, "Your Heart." A: The Stethoscope B: Blood Pressure C: Blood Pressure and Exercise D: Your Heart and Exercise
1.3 Differentiate between the systolic and diastolic stages of the heartbeat.		Hypertension--AV tape presentation, SPENCO.
2.0 Identify types of heart diseases, define heart failure, and describe the cause(s) and treatment(s).	Do research on heart attack, atherosclerosis, angina pectoris, heart failure.	Microbiology and Pathology: Chapter 41, "Circulatory Disorders." A Survey of Human Diseases: Chapter 13, "Cardiovascular Medicine." Biology: The Science of Life: "The Cardiovascular Systems."
3.0 Compare the structure of arteries, arterioles, capillaries, venules and veins.	Examine prepared slides of blood vessels. Demonstrate presence of veins in the arm.	Biology: The Science of Life: Chapter 34, "The Circulatory Systems." Biology of Ourselves: A Study of Human Biology: Chapter 10, "The Heart and Circulation of the Blood."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
3.1 Relate the structure of the capillary to its role as the site of exchange in the circulatory system.	Observe capillary function in a goldfish or frog.	
4.0 Compare the structure, function and site of manufacture of the formed elements of the blood.	Examine prepared blood smears. Prepare and stain blood smears.	Biology of Ourselves: A Study of Human Biology: Chapter 9, "Composition of the Blood." Biology: The Science of Life: Chapter 34, "The Circulatory System." Bodyworks: Your Human Biology: Chapter 6, "Your Blood." Laboratory Biology: Investigating Living Systems: Lab 64, "Blood." A Survey of Human Diseases: Chapter 11, "Hematology." Film: The Blood, Manitoba Education. A: ABO Blood Grouping B: Hemoglobin C: Blood Clotting D: White Blood Cell Count E: Red Blood Cell Count

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
4.1 Describe blood groups, including Rh.	Do a lab on blood grouping, including Rh.	
4.2 Describe the components of the blood-clotting mechanism.	Do a lab on blood clotting. Research blood fractions, e.g., factor 8.	
5.0 Describe the role of the circulatory system in homeostasis.	Research the interaction between the respiratory and circulatory systems. View film, "Function of Circulatory Systems."	Biology of Ourselves: A Study of Human Biology: Chapter 7. "Hemo the Magnificent," MTS. Film: Function of Circulatory Systems, Manitoba Education.
5.1 Describe the role of the circulatory system in immunity.		Biology: The Science of Life: Chapter 34. Films: Importance of Immunity and From One All, NFB.

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
6.0 Describe lymph nodes with regard to: - sites - structure - function	Examine specimens, models, slides or illustrations of lymphatic vessels and tissues. Compare to blood circulatory systems of a variety of animals.	Biology of Ourselves: A Study of Human Biology: Chapter 10, "The Heart and Circulation of the Blood." Biology: The Science of Life: Chapter 34, "The Circulatory System." Microbiology and Pathology: Chapter 12, "Immunology."
6.1 Describe lymphatic circulation with regard to: - function - means of transportation - association with the blood circulatory system		
6.2 Compare structure and functions of the lymphatic system to the blood circulatory system.		"Cancer and Cells" (diagram), Canadian Cancer Society.

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
EXTENSIONS		
Anticoagulants		
The student should be able to:		
1.0 Discuss the use of natural and synthetic anticoagulants.	Obtain samples of or literature on anticoagulants; e.g., determine precautions to be taken by people taking anticoagulants.	Microbiology and Pathology: Chapter 41, "Circulatory Disorders."
Blood Disorders		
The student should be able to:		
1.0 Investigate selected blood disorders.	Do research on leukemia, hemophilia. Compare the following types of anemia: - sickle-cell - iron deficiency - pernicious View prepared blood slides.	Biology of Ourselves: A Study of Human Biology: Chapter 9, "Composition of the Blood." A Survey of Human Diseases: Chapter 11, "Hematology."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
Fitness of Cardiovascular Systems The student should be able to: 1.0 Describe the effect of diet, lifestyle, physical condition and age on blood and the cardiovascular systems.	Analyze case studies. Perform labs on heart rate and blood pressure. Follow recommendations in Participaction package.	Biology of Ourselves: A Study of Human Biology: Chapter 10, "The Heart and Circulation of the Blood" (case study). Bodyworks: Your Human Biology: Chapter 7, "Your Heart." Participaction, 80 Richmond Street West, Suite 805, Toronto, Ontario.
Comparative Anatomy of Circulatory Systems The student should be able to: 1.0 Compare the circulatory systems of selected organisms.	Examine specimens, models, charts or descriptions of a variety of invertebrates and vertebrates.	Addison-Wesley Biology: Chapter 9, "Transport." Biology: The Science of Life: Chapter 34, "The Circulatory System."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
Circulatory Disorders		
The student should be able to:		
1.0 Investigate the types, causes and treatment of malfunction of arteries and veins.	Compare arteriosclerosis, atherosclerosis, aneurysms, thrombosis. Discuss phlebitis, varicose veins, thrombosis, hemorrhoids. Research the effects of thrombosis on a vein and an artery.	Biology of Ourselves: A Study of Human Biology: Chapter 10, "The Heart and Circulation of the Blood." A Survey of Human Diseases: Chapter 11, "Hematology." Microbiology and Pathology: Chapter 41, "Circulatory Disorders"; Chapter 21, "The Vascular System."
Body Defense		
The student should be able to:		
1.0 Discuss body defenses and phagocytosis.	View film, From One Cell.	Biology of Ourselves: A Study of Human Biology: Chapter 11, "Body Defense." Biology: The Science of Life: Chapter 34, "The Circulatory System." Film: From One Cell, Cancer Society.

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
Immunity		
The student should be able to:		
1.0 Describe the role of the lymphatic system in immune reactions.	Research the role of the lymphatic system in immunity.	Biology of Ourselves: A Study of Human Biology: Chapter 11, "Body Defense." Biology: The Science of Life: Chapter 34, "The Circulatory System." Microbiology and Pathology: Chapter 12, "Immunology."
Fetal Circulation		
The student should be able to:		
1.0 Discuss the differences in an adult and fetal circulation.	Examine specimens, models or diagrams of fetal circulation, then compare to adult circulation.	Biology of Ourselves: A Study of Human Biology: Chapter 19, "Pregnancy and Birth." Biology: The Science of Life: Chapter 40, "The Reproductive System."
Lymphatics and Digestion		
The student should be able to:		
1.0 Explain how the lymphatic system is involved in the absorption of nutrients.		Biology of Ourselves: A Study of Human Biology: Chapter 13, "The Digestive System."

UNIT V: TITLE: Respiratory System TIME: 6-8 hours (core)

RATIONALE: Respiration is the process of exchange in which oxygen is taken in from the outer environment of a living organism and carbon dioxide is removed. Gas exchange occurs both at the cellular level and at the level of the respiratory organ. This unit covers the structure and functions of respiratory organs and the chemical and mechanical stages involved in gas exchange, as well as a close examination of the association between the circulatory and respiratory systems, with special attention to hemoglobin. There is also a discussion of the defence systems and homeostatic mechanisms which are related to the respiratory system; and the related topics of disorders of the respiratory system, comparative anatomy of respiratory systems, and the heart-lung machine.

SECONDARY REFERENCE:

1. Fisher, Arthur. The Healthy Heart. Chicago, IL: Time-Life Books, 1981.

TEACHER REFERENCE:

1. Andrews, W.A., et al. Biological Science: An Introductory Study. Scarborough, ON: Prentice-Hall of Canada Ltd., 1980.

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
The student should be able to:		
1.0 Differentiate between internal and external respiration. 1.1 Identify the structure and function of the respiratory system.	Dissect animal lungs. Examine prepared slides of respiratory organs.	1.0-1.1 Biology of Ourselves: A Study of Human Biology: Chapter 12, "Breathing." Addison-Wesley Biology: Teacher Resource. Unit 3, "The Respiratory System." Addison-Wesley Biology: Chapter 7, "Gas Exchange."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
		Biology: The Science of Life: Chapter 32, "The Respiratory System and Breathing." Laboratory Biology: Investigating Living Systems: Lab 62, "Respiratory System." Biology of Ourselves: A Study of Human Biology: Chapter 12, Activity 2, 3; Chapter 17, "Mechanisms of Breathing." Laboratory Biology: Investigating Living Systems: Lab 65, "Lung Capacity." Bodyworks: Your Human Biology: Lab 8, "Respiration Values."
1.2 Compare the mechanics of inspiration to that of expiration.	Do a lab to measure lung capacity. Demonstrate lung action using a model of the lung.	
2.0 Describe the interaction between the respiratory and circulatory systems.	Do a lab to measure metabolic rate via carbon dioxide production or oxygen consumption.	2.0-2.1
2.1 Describe the role of hemoglobin in respiration.	Do a demonstration correlating a variety of respiratory rates with pulse rates; e.g., 10 breaths/minute ⟶ heart rate; breath hold for 1 minute ⟶ heart rate.	Biology of Ourselves: A Study of Human Biology: Chapter 12, Activity 1.

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
3.0 Describe the defence mechanisms of the respiratory system.	Analyze the step-by-step events of the cough or sneeze reflex. Explain the action of cilia.	Biology of Ourselves: A Study of Human Biology: Chapter 12, "Breathing."
EXTENSIONS		
Disorders of the Respiratory System		
The student should be able to:		
1.0 Discuss the effect of several lifestyle factors on the respiratory system.	1.0-1.1	1.0-1.1
1.1 Explain the cause, symptoms and treatment of several important respiratory disorders.	Examine the effects of environmental factors on the respiratory system. Do labs or demonstrations on the effects of smoking. Examine the pathology of disorders such as lung cancer, emphysema, common cold, tuberculosis, pneumonia, sudden infant-death syndrome (SIDS).	Biology of Ourselves: A Study of Human Biology: Chapter 12, Activities 4-8. Biology: The Science of Life: Chapter 32. Current Health Problems: "Chronic Diseases." A Survey of Human Diseases: Chapter 14, "Pulmonary Diseases."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
Comparative Anatomy and Physiology of Respiratory Systems		
The student should be able to:		
1.0 Identify a variety of mechanisms by which animals accomplish gas exchange.	Compare the structure of the respiratory mechanisms of a grasshopper, fish and mammal.	Biology: The Science of Life: Chapter 32, "The Respiratory System and Breathing."
1.1 Relate the efficiency of gas exchange to the metabolic requirements of the organism.		
Heart-Lung Machine		
The student should be able to:		
1.0 Compare the function of the heart-lung machine with the physiology of the human respiratory system.	Discuss the relationship between the structure of the heart-lung machine and its function.	The Healthy Heart The Manitoba Lung Association (For information: 629 McDermot Avenue, Winnipeg, 774-5501.)

UNIT VI: TITLE: Excretory System TIME: 3-5 hours (core)

RATIONALE: The toxic metabolic wastes produced by living organisms must be eliminated. Organisms usually possess organs and/or systems especially equipped to eliminate metabolic wastes. These organs and/or systems reclaim essential substances in the toxic wastes through a selection process. The excretory system plays a vital role in the homeostasis of the living organism. This unit covers the structure and functions of the human excretory system, including a discussion of its place in homeostasis, and analysis of urine, and malfunctions of the excretory system.

SECONDARY REFERENCES:

1. BSCS Blue Version. Biological Science: A Molecular Approach. Boulder, CO: D.C. Heath and Co., 1980.

2. BSCS Yellow Version. Biological Science: An Inquiry into Life. New York: Harcourt Brace Jovanovich, 1980.

3. Evans, William F. Anatomy and Physiology. Third edition. New Jersey: Prentice-Hall Inc., 1983.

TEACHER REFERENCES:

1. Purtilo, David T. A Survey of Human Diseases. Don Mills, ON: Addison-Wesley Publishing Co., 1980.

2. Andrews, W.A., et al. Biological Science: An Introductory Study. Scarborough, ON: Prentice-Hall of Canada Ltd., 1980.

3. Volpe, E. Peter. Biology and Human Concerns. Third edition. Dubuque, IA: Wm. C. Brown Co., 1983.

4. Patricia J. Houlihan. "When Your Patient Is a Transplant," The Canadian Nurse, vol. 78, no. 7 (July/August 1982).

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
The student should be able to:		
1.0 Identify the parts of the human excretory system and their functions.	Dissect a pig kidney to examine the major areas and structures. (This should be done as a demonstration.)	Addison-Wesley Biology: Teacher Resource. Unit 4, "The Excretory System." Biology of Ourselves: A Study of Human Biology: Chapter 16.
2.0 Apply the concepts of osmosis, diffusion and active transport to functional parts of the nephron.	* Do a lab on factors affecting diffusion through a membrane. NOTE: The above labs may be done in conjunction with cell structure unit.	Addison-Wesley Biology: Chapter 10, "Excretion." Biology of Ourselves: A Study of Human Biology: Chapter 16. Laboratory Biology: Investigating Living Systems: Lab 13, "Cell Membranes and Permeability"; Lab 14, "Normal and Plasmolyzed Cells."
2.1 Describe the filtering mechanism and the reabsorptive stages of the nephron.		Addison-Wesley Biology: Laboratory Manual: Experiment 32, "The Kidney."
3.0 Describe the role of the excretory system in homeostasis.		Biology of Ourselves: A Study of Human Biology: Chapter 16.

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
		Biology: The Science of Life, Chapter 35.
4.0 List and describe the constituents of urine.	* Do urinalyses of students who have been placed on a variety of diets.	Biology of Ourselves: A Study of Human Biology: Chapter 16, Activity 1. Biology: The Science of Life: Chapter 35. Laboratory Biology: Investigating Living Systems: Lab 66, "Urinalysis." Bodyworks: Your Human Biology: Chapter 11, "Kidney."
EXTENSIONS Malfunctions The student should be able to:		
1.0 Identify the following malfunctions of the excretory system: - urinary calculi - urethritis - renal failure - loss of urinary bladder control		Biology: The Science of Life: Chapter 35.

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
2.0 Describe kidney dialysis and the Continuous Ambulatory Peritoneal Dialysis methods of kidney support.		Biology of Ourselves: A Study of Human Biology: Chapter 16. Biological Science: A Molecular Approach: Biology Brief. Biology and Human Concerns: Chapter 10, "The Artificial Kidney." Manitoba Kidney Foundation, Information Brochures.
3.0 Review the successes and failures of kidney transplants.		Biology and Human Concerns: Chapter 13, "Homeostasis." Manitoba Kidney Foundation, Information Brochures. "When Your Patient Is a Transplant," The Canadian Nurse.

UNIT VII: TITLE: Nervous System TIME: 6-8 hours (core)

RATIONALE: This unit will provide the student with the opportunity to investigate the basic mechanisms by which the nervous system is able to coordinate and control the many body functions. This basic knowledge is necessary if the student is to appreciate the consequences, both positive and negative, of lifestyle factors and health on the efficiency of the nervous system in exercising its control. This unit covers a discussion of the structure and functions of the nervous system. It also includes a discussion of disorders of the nervous system and its receptors, pain control, and the effects of chemicals on the nervous system.

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
The student should be able to: 1.0 Identify the functions of parts of the nervous system. Describe the importance of the following processes to nerve system function: - reception - interpretation - sorting and transmission		Addison-Wesley Biology: Teacher Resource. Unit 6, "The Nervous System." Addison-Wesley Biology: Chapter 13, "Nervous Control." Biology of Ourselves: A Study of Human Biology: Chapter 6, "The Nervous System." Biology: The Science of Life: Chapter 36, "The Nervous System and Co-ordination."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
1.1 Identify the structural parts of sensory, motor and associative neurons.	Examine microscope slides of nerve tissue containing these cells.	
1.2 Describe the arrangement of neurons in a reflex arc.	Do a lab to measure reaction time, sneeze reflex, uvula reflex, etc.	1.2-1.3 Bodyworks: Your Human Biology: Lab 5b, "Reaction Measurement." Biology of Ourselves: A Study of Human Biology: Chapter 6, Activities 1-8. Biology of Ourselves: A Study of Human Biology: Chapter 6. Biology: The Science of Life: Chapter 36. "Constructing a Model of a Nerve Cell," Science Teacher, vol. 48, no. 1 (January 1981). Addison-Wesley Biology: Laboratory Manual: Experiment 36, "Reflex Action."
1.3 Discuss the mechanisms of nerve impulse propation in terms of a simplified model.		

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
2.0 Identify the parts of the central nervous system. 2.1 Discuss the role of the brain and spinal cord in the central nervous system.	Dissect an animal.	2.0-2.1 Biology of Ourselves: A Study Into Human Biology: Chapter 6, "The Nervous System." Biology: The Science of Life: Chapter 36, "The Nervous System and Co-ordination."
3.0 Identify the components of the peripheral nervous system.		
3.1 Explain the mechanism by which the peripheral system regulates the activity of involuntary organs to achieve homeostasis.	Discuss such activities as control of pupil size, heart rhythm and rate, breathing rhythm and rate, tonus, and bladder control.	
4.0 Identify the sensory receptors of the body.	Do a lab on touch discrimination, taste and balance.	4.0-4.2 Addison-Wesley Biology: Laboratory Manual: Experiment 38, "Perception of Touch, Temperature, Smell and Taste." Addison-Wesley Biology: Chapter 14, "The Senses."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
4.1 Identify the structure and function of the parts of the eye and ear.	* Do labs on: - accommodation - visual field - visual acuity - colour vision - ox eye dissection - blindspot - dominant eye Do a lab with the eye resolution test.	Biology of Ourselves: A Study of Human Biology: Chapter 2, "The Skin"; Chapter 7, "The Eye and Vision." Biology: The Science of Life: Chapter 36. Addison-Wesley Biology: Laboratory Manual: Experiment 39, "Visual Perception." Bodyworks: Your Human Biology: Lab 9A-1. Laboratory Biology: Investigating Living Systems: Lab 72, "Reliability of Your Visual Sense." Biology of Ourselves: A Study of Human Biology: Chapter 8, Activities 1-5. "Experiment for Testing Eye Resolution," Science Teacher, vol. 48, no. 9 (December 1981).
4.2 Relate the (events) processes of seeing and hearing to nervous system activity.		

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
EXTENSIONS		
Disorders of the Nervous System and Its Receptors		
The student should be able to:		
1.0 Describe the causes, effects and treatment of common nervous disorders, e.g., stroke, epilepsy, multiple sclerosis, meningitis, concussion, Parkinson's disease.		Biology: The Science of Life: Chapter 36. A Survey of Human Diseases: Chapter 21, "Neurology and Neuropathology."
Pain Control		
The student should be able to:		
1.0 Describe the current hypothesis of pain production.		Biology of Ourselves: A Study of Human Biology: Chapter 6, pages 148, 161.
1.1 Explain the effects of culture and mental state on the sensation of pain.		
1.2 Examine the methods by which pain is controlled.	Do library research on the work of Wilder Penfield, R. Melzack.	Films: Gateway to the Mind, Manitoba Telephone System (1 hour) and Something Hidden: A Portrait of Wilder Penfield, NFB.

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
	Discuss the roles of ESB (electrostimulation of the brain), acupuncture, hypnosis and drugs in pain control.	Biology of Ourselves: A Study of Human Biology: Chapter 6, "Brain Maps."
Chemicals and the Nervous System		
The student should be able to:		
1.0 Discuss critically the physiological effects of depressants and stimulants on the nervous system.	Invite such guest lecturers as public health nurses or detoxification workers to talk to students.	Biology of Ourselves: A Study of Human Biology: Chapter 6.

UNIT VIII: TITLE: Endocrine System

RATIONALE: The endocrine system is one of the regulatory control systems in living organisms. The endocrine glands (or organs) secrete chemical substances (hormones) that regulate important body activities. This unit identifies these organs and hormones and their functions, and includes a discussion of endocrine disorders.

SECONDARY REFERENCES:

1. BSCS Blue Version. Biological Science: A Molecular Approach. Boulder, CO: D.C. Heath and Co., 1980.

2. BSCS Yellow Version. Biological Science: An Inquiry Into Life. New York: Harcourt Brace Jovanovich, 1980.

TEACHER REFERENCES:

1. Purtilo, David T. A Survey of Human Diseases. Don Mills, ON: Addison-Wesley Publishing Co., 1980.

2. Andrews, W.A., et al. Biological Science: An Introductory Study. Scarborough, ON: Prentice-Hall of Canada Ltd., 1980.

3. Evans, William F. Anatomy and Physiology. Third edition. New Jersey: Prentice-Hall Inc., 1983.

4. Volpe, E. Peter. Biology and Human Concerns. Third edition. Dubuque, IA: Wm. C. Brown Co., 1983.

5. Garden, Janet E. and Robert A. Richardson. Chemistry of the Body. Toronto, ON: John Wiley and Sons, 1985.

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
The student should be able to:		
1.0 Identify organs involved in endocrine activity.	View prepared slides.	Addison-Wesley Biology. Teacher Resource. Unit 5, "The Endocrine System." Addison-Wesley Biology: Chapter 12, "Chemical Control." Biology of Ourselves: A Study of Human Biology: Chapter 17.
1.1 Describe the hormonal control of endocrine glands by the "master" or pituitary gland.	* Use the laboratory activity, "The Thyroid Gland," to examine both the normal and abnormal functioning of this gland.	Biology: The Science of Life: Chapter 37. Laboratory Biology: Investigating Living Systems: Lab 69, "Thyroid Gland." Biology of Ourselves: A Study of Human Biology: Chapter 17. Biology: The Science of Life: Chapter 37.
1.2 Describe for each of the endocrine organs: . site of manufacture . hormone secreted . hormonal function(s)	Demonstrate the effect of thyroxin on the metamorphosis of tadpoles.	Biology of Ourselves: A Study of Human Biology: Chapter 17. Biology: The Science of Life: Chapter 37.

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
1.3 Identify the roles of endocrine systems in homeostatic regulation.		Biology of Ourselves: A Study of Human Biology: Chapter 17.
EXTENSIONS		
Endocrine Disorders		
1.0 Describe the following endocrine disorders: - diabetes mellitus - diabetes insipidus - dwarfism - giantism - cretinism - myxedema under the following headings: - cause(s) - symptoms - treatment	Invite guest speaker from the Canadian Diabetic Association.	Addison-Wesley Biology: Teacher Resource. Unit 5, "The Endocrine System." Biology of Ourselves: A Study of Human Biology: Chapter 17, "Case Study."
2.0 Describe the relationship of the endocrine system to the hypothalamus.		Biology of Ourselves: A Study of Human Biology: Chapter 3, "Regulations of Body Temperature."

UNIT IX: TITLE: Reproduction and Development TIME: 8-10 hours (core)

RATIONALE: Sexual reproduction is the means by which humans propagate themselves according to the laws of natural selection. Since virtually all senior-high-school students are sexually mature, it is essential that they know the basic anatomy and physiology of human reproductive systems. This unit covers discussion of the structures and functions of the reproductive organs, hormonal regulation, contraception, pregnancy and birth as well as a discussion of diseases of the reproductive systems, Rh incompatibility and congenital birth defects.

SECONDARY REFERENCES:

1. BSCS Yellow Version. Biological Science: An Inquiry Into Life. New York: Harcourt Brace Jovanovich, 1980.

TEACHER REFERENCES:

1. Stine, W.R. Applied Chemistry. Second edition. Toronto: Allyn and Bacon, 1981.
2. Smith, A.L. Microbiology and Pathology. St. Louis, MI: C.V. Mosby, 1980.
3. Moore, Keith. Before We Are Born. Philadelphia: W.B. Saunders, 1974.
4. Pattison, E.M. The Experience of Dying. Englewood Cliffs, NJ: Prentice-Hall Inc., 1977.
5. Evans, William F. Anatomy and Physiology. Third edition. New Jersey: Prentice-Hall Inc., 1983.
6. Volpe, Peter E. Biology and Human Concerns. Third edition. Dubuque, IA: Wm. C. Brown Co., 1983.

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
The student should be able to:		
1.0 Identify the major anatomical structures and functions of the male and female reproductive systems.	Examine models, charts and diagrams.	Addison-Wesley Biology: Teacher Resource. Unit 8, "The Reproductive System." Addison-Wesley Biology: Chapter 18, "Reproduction and Development of Vertebrates." Biology of Ourselves: A Study of Human Biology: Unit 10, "Reproduction and Heredity"; Chapter 18, "Changes in the Reproductive System." Biology: The Science of Life: Chapter 40, "The Reproductive System." Bodyworks: Your Human Biology: Lab 15, "Your Reproductive System." Biological Science: An Inquiry Into Life: Chapter 16, "Reproduction and Development."
2.0 Discuss the hormonal regulation of male and female reproductive systems.	Relate hormonal level to structural changes in the reproductive system.	Addison-Wesley Biology: Chapter 12, "Chemical Control." Biology of Ourselves: A Study of Human Biology: Chapter 18."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
2.1 Discuss the menstrual cycle.		Biology: The Science of Life: Chapter 40. Laboratory Biology: Investigating Living Systems: Lab 57, "The Menstrual Cycle." Biological Science: A Molecular Approach: Chapter 16.
3.0 Describe anatomical and physiological barriers to fertility.	This could be handled as a option, considering this topic in a broader context (e.g., population control, quality of life). Discuss reasons for in vitro implantations, ectopic pregnancy, impotence, fertility drugs.	Science in Society - Book B: "Population and Health." Biology of Ourselves: A Study of Human Biology: Chapter 18. Applied Chemistry: Chapter 23, "Steriods and Birth Control." Biology: The Science of Life: Essay 40-1, "Birth Control." Current Health Problems: Section 3, "Human Sexuality and the Sexual You." Biological Science: An Inquiry Into Life: Chapter 16.

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
4.0 Compare the processes of meiosis and mitosis.	* Do a lab on meiosis and mitosis using a model or diagram.	4.0-4.2 Biology of Ourselves: A Study of Human Biology: Chapter 20.
4.1 Describe the process of fertilization.	Examine a mammalian embryo.	Addison-Wesley Biology: Chapter 15, "Reproduction of Molecules and Cells"; Chapter 16, "Reproduction of Organisms."
4.2 Describe the characteristics of human embryonic development during each of the three trimesters of pregnancy.	Refer to diagram of human fetuses. Do a research project on: - test tube babies - artificial insemination - effect of lifestyle on fetal development	Biology: The Science of Life: Chapter 40. Laboratory Biology: Investigating Living Systems: Lab 58, "Chick Development"; Lab 17, "Comparing Mitosis and Meiosis."
4.3 Describe parturition.	View films on childbirth.	Anatomy and Physiology: Chapter 16, "Reproduction and Development." Biological Science: An Inquiry Into Life: Chapter 16. Life Before Birth, Time-Life Books (AV Film and Cassette). Miracle of Life, Manitoba Health Discover (September 1982).

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
5.0 Describe methods used in the diagnosis of pregnancy.	Research: - hormonal studies - ultrasound - x-ray	Biology of Ourselves: A Study of Human Biology: Chapter 19, "Pregnancy and Birth." A Survey of Human Diseases: Chapter 3.
5.1 Describe methods used to detect fetal abnormalities.	Discuss such detection methods as amniocentesis, ultrasound, and biopsy of chorionic villi.	Science in Society: Medicine and Care.
5.2 Describe the physical changes associated with: - infancy - puberty - middle age - old age - death	Compare selected physical characteristics of various age groups, e.g., muscle mass, bone development. View x-rays and illustrations.	Biology of Ourselves: A Study of Human Biology: Chapter 19, "Pregnancy and Birth." The Experience of Dying.
EXTENSIONS		
Birth Control		
The student should be able to:		
1.0 Describe from a historical perspective, the various male and female birth control methods (past, present, future).		Biology and Human Concerns: Chapter 2, "Control of Fertility."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
		Applied Chemistry: Chapter 23, "Steroids and Birth Control." Biology: The Science of Life: Essay 40-1, "Birth Control." Biological Science: An Inquiry Into Life: Chapter 16.
Diseases of the Reproductive System The student should be able to: 1.0 Examine diseases of the reproductive systems.	Do research on diseases such as cervical cancer, endometriosis, herpes simplex II, prostate malfunctions, breast cancer, syphilis and gonorrhea.	Biology of Ourselves: A Study of Human Biology: Chapter 18, "Sexually Transmitted Diseases." Biology: The Science of Life: Chapter 40, "The Reproductive System." Microbiology and Pathology: Chapter 54, "Diseases of the Male Reproductive Organs"; Chapter 55, "Diseases of the Female Reproductive System."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
Rh Incompatibility		
The student should be able to:		
1.0 Discuss Rh incompatibility under the headings: - cause(s) - symptoms - treatment(s)	Research probability of significant disability resulting from Rh incompatibility.	Biology and Human Concerns: Chapter 22, "Human Blood Groups and Hemolytic Disease."
Congenital Birth Defects		
The student should be able to:		
1.0 Investigate congenital birth defects.	Compare illustrations of birth defects. Relate gestational age to probability of specific congenital defects. Research the effects of congenital anomalies on lifestyle of the following conditions: - cleft palate - heart defects - club foot - hydrocephalus	Biology of Ourselves: A Study of Human Biology: Chapter 20, "Human Genetics." Microbiology and Pathology: Chapter 40, "Birth Defects."

biology 200 (options)

UNIT DESIGN CHARTS FOR BIOLOGY 200 OPTIONS

OPTION A: TITLE: Cancer TITLE: 10 hours

RATIONALE: Cancer is the second leading cause of death in Canada. This unit on cancer is included among the Biology 200 options to help inform students about the actions they can take to avoid cancer. Students require basic information as early as possible in their lives in order to maximize the effectiveness of any action they choose to take to improve their future health. This unit can make students aware of the changing focus of health care from that of treatment to that of prevention. This unit can also help counteract the widely held view among students and the public that "everything causes cancer and therefore nothing can be done."*

PRIMARY REFERENCE:

1. Canadian Cancer Society. The Wild Cells and The Source Book for Teachers and Students. Room 202 - 960 Portage Avenue, Winnipeg, 1980.**

SECONDARY REFERENCES:

1. Cairns, John. Cancer: Science and Society. San Francisco: W.H. Freeman, 1978.
2. Time-Life Books. Fighting Cancer. GLC Publishing, 1981.

TEACHER REFERENCES:

1. Purtilo, David. A Survey of Human Diseases. Don Mills, ON: Addison-Wesley Publishing, 1978.
2. Volpe, Peter E. Biology and Human Concerns. Third edition. Dubuque, IA: Wm. C. Brown Co., 1983.
3. Kimball, John W. Man and Nature: Principles of Human and Environmental Biology. Don Mills: Addison-Wesley Publishing, 1985.

*Teachers should be aware that students may have studied aspects of cancer in Science 100 or 101.

**The Cancer Society has provided the teaching kit, "The Wild Cells," to each school division. Additional copies can be purchased for $40.00. The kit includes two books, The Wild Cells and The Source Book for Teachers and Students, as well as twenty 35-mm slides on the topic.

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
The student should be able to:		
1.0 Describe the differences between normal cell growth and the growth of cancerous tissue.	Do activities on page 3 of the Wild Cells.	The Wild Cells, "What is Cancer?" Cancer: Science and Society: Chapter 3, "The Origin and Variety of Cancer." Fighting Cancer, "Victories of a Dread Disease." A Survey of Human Diseases: Chapter 8, "Neoplasia."
1.1 Distinguish between normal tissue and cancerous tissue.	Examine microscopic slides of cancerous and normal tissue.	Biology and Human Concerns: Chapter 15, "Cancer and Cardiovascular Diseases."
1.2 Differentiate between the two types of tumors in terms of cell characteristics and capacity to spread.	Discuss the properties of benign and malignant tumors. Use 35-mm slides or microslides to illustrate.	The Wild Cells, "Types of Cancer." Cancer: Science and Society: Chapter 3.
1.3 Describe the four main stages of cancer metastasis and the reasons for early diagnosis.	Discuss the role of the transport system in the spreading of cancer cells.	The Wild Cells, "What is Cancer?" Fighting Cancer: Chapter 4, "Intimate Profile of a Wayward Cell."
2.0 List several causes of cancer that are natural and several that are caused by humans.	Use charts, graphs or tables to relate incidence of cancer to a variety of circumstances.	The Wild Cells, "Why Study Cancer?" Cancer: Science and Society, "The Epidemiology of Cancer."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
2.1 Identify the most common cancers of men and women and relate these to specific lifestyles or environmental factors.	Use graphs and charts to illustrate the relative rates of occurrence.	Fighting Cancer: Chapter 2, "Sidestepping the Causes." Cancer: Science and Society: Chapter 4, "The Epidemiology of Cancer." A Survey of Human Diseases: Chapter 8, "Neoplasia."
3.0 Describe the mechanism by which the body normally removes cancerous cells.	Examine microslides of lymphatic tissue.	The Wild Cells, "What is Cancer?" Fighting Cancer: Chapter 4.
3.1 Identify the methods used in the detection of skin, lung, leukemia, breast, cervical, prostate and testicular cancer.	Discuss methods used to detect cancer. Examine a pap smear. Do a mole mapping lab. Discuss the breast self-examination technique and if possible bring in a public health nurse to demonstrate.	Fighting Cancer: Chapter 3, "Unmasking the Enemy" and "An Encyclopedia of Symptoms." The Wild Cells, "Symptoms and Detection." A Survey of Human Diseases: Chapter 8, "Neoplasia."
3.2 Identify the advantages and disadvantages of the three standard forms of cancer treatment.	Discuss the use of chemotherapy and radiation in the treatment of some of the cancers mentioned in 3.1.	Fighting Cancer: Chapter 4, "Saving Lives with Killer Rays"; Chapter 5, "A Dream Come True: Cures that Work." Source Book for Teachers and Students, "Treatment," page 7, "Methods of Treatment," page 22.

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
		American Cancer Society, "Facts on Cancer Treatment." Cancer: Science and Society: Chapter 10, "Prospects for the Future." The Wild Cells: "Recent Advances in Cancer Research" and "Treatment."
4.0 Describe the consequences of high risk activities on your future. Compare potential risks and ways that risks can be lowered.	Examine the influence of diet, occupation and personal lifestyle on the incidence of cancer and discuss ways in which the student can directly control these factors.	Cancer: Science and Society: Chapter 4, "The Epidemiology of Cancer"; Chapter 10, "Prospects for the Future." Man and Nature: Principles of Human and Environmental Biology: Chapter 6, "The Respiratory System" (data concerning smoking and diseases).
5.0 Describe the problems of coping with cancer.		Fighting Cancer: Chapter 6, "Coping with Cancer."
6.0 Analyze some misleading presentations of cancer research.	Discuss how statistics, especially percentages, can give a distorted idea of the effect of environmental factors on the incidence of cancer. E.g., if a particular environmental factor is said to increase a certain cancer rate by 200%, the implication is that the number of new cancer cases will be large. However, if the rate is one in 100,000, a 200% increase means only one more case of cancer.	

OPTION B: TITLE: Basic Ecology TIME: 10 hours

RATIONALE: This unit, Basic Ecology, provides background information which shows the reltionship of humans to their environment. An examination of the abiotic and biotic components in the environment and their interreltionships provides the necessary foundation for the study of the option units on population ecology and/or environmental issues. Some topic areas that have been covered in previous grades may require only review.

PRIMARY REFERENCES:

1. Rahn, Joan E. Biology: The Science of Life. Second edition. New York: Macmillan Publishing Co., Inc., 1980.

2. Kormondy, Edward J., and Bernice E. Essenfeld. Addison-Wesley Biology. First edition. Don Mills, ON: Addison-Wesley, 1984.

3. Kaskel, Albert, et al. Laboratory Biology: Investigating Living Systems. Colulmbus, OH: Charles E. Merrill Publishing Co., 1983.

TEACHER REFERENCES:

1. Miller, G. Tyler, Jr. Living in the Environment. Third edition. Belmont, CA: Wadsworth Publishing Co., 1982.

2. Volpe, Peter E. Biology and Human Concerns. Third edition. Dubuque, IA: Wm. C. Brown Co., 1983.

3. McCormack, Alan J., et al. Biology Laboratory Manual. Glenview, IL: Scott Foresman and Co., 1980.

4. Slesnick, Irwin, et al. Biology. Glenview, IL: Scott Foresman and Co., 1980.

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
The student should be able to:		
1.0 Define the term ecology.		Addison-Wesley Biology: Chapter 1, "The World of Life"; Chapter 22, "Interactions and the Ecosystem." Biology and Human Concerns: Chapter 47, "The Ecosystem."
2.0 Identify abiotic and biotic components in the environment.	Administer a biotic-abiotic item survey.	Biology: The Science of Life: Chapter 5, "The Physical Environment." Biology and Human Concerns: Chapter 44, "Interactions of Populations."
3.0 Describe bio-geochemical cycles in our environment.	Conduct a classroom study of hydrological, carbon-oxygen, nitrogen and phosphorus cycle.	Biology: The Science of Life: "Cycles of Matter." Biology and Human Concerns: Chapter 47, "The Ecosystem."
4.0 Define and give examples of an autotroph and heterotroph.	Determine the biotic status of fungi, algae, bacteria and viruses.	Biology and Human Concerns: Chapter 45, "Biotic Communities: Plants as Producers."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
4.1 Identify the heterotroph levels in an ecosystem.	Cite examples of primary, secondary and tertiary consumer levels. Discuss humans as heribores/vegetarians/carnivores and omnivores.	
4.2 Define the following ecological terms: - niche - food chain - pyramids - food webs - top carnivores	Construct a food web and determine members autotrophs, heterotrophs, food chain, primary, secondary, tertiary consumers and top carnivores.	Biology: The Science of Life: Chapter 14, "Food Chains and Food Webs." Biology and Human Concerns: Chapter 46, "Biotic Communities: Energy Flow."
4.3 Define the following terms: - community - ecosystem - biome	Cite the major ecosystems in the province of Manitoba. View audio filmstrip, "What is Ecology," Warren Schloat Productions.	Biology: The Science of Life: Chapter 6, "Succession in Communities." Biology and Human Concerns: Chapter 46, "Biotic Communities: Energy Flow." Laboratory Biology Investigating Living Systems: Lab 79, "A Soil Community"; Lab 80, "Microcommunities" Addison-Wesley Biology: Chapter 23, "Populations and Ecosystems."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
5.0 Describe the stages of plant succession.	Cite examples of primary and secondary succession. Conduct a schoolyard plant sucession survey.	Biology: The Science of Life: Chapter 6, "Succession and Communities."
6.0 Describe the role of weeds in ecology.	Do a laboratory and field study investigation of the dandelion.	"Ecology of the Weed," American Biology Teacher, vol. 38, no. 3 (March 1976), p. 157.
7.0 Give an example of the effect of human populations on their environments. Describe potential and actual positive and negative effects and give information to support the statement.	Do a thermal pollution laboratory investigation.	Living in the Environment: Part 3, "Population Resource and Pollution"; Part 4, "Environment and Society"; Part 5, "Enrichment Studies." Biology and Human Concerns: Chapter 48, "Human Modification of the Environment"; Chapter 47, "The Ecosystem." Biology: The Science of Life: Chapter 14, "Food Webs and the Stability of Communities"; Chapter 14, "Pollution and Food Chains"; Chapter 13, "Significance of the Cycles"; Chapter 6, "Lakes." Laboratory Biology: Investigating Systems: Lab 81, "Thermal Pollution."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
		Laboratory Biology: Investigating Systems: Lab 81, "Thermal Pollution."

OPTION C: TITLE: Population Ecology TIME: 10 hours

RATIONALE: This unit gives information on the characteristics of individual populations and shows how various populations interact with each other. The knowledge imparted in this unit on population ecology serves as a prerequisite to further studies on human populations and their effect on the environment.

PRIMARY REFERENCES:

1. Rahn, Joan E. Biology: The Science of Life. Second edition. New York: Macmillan Publishing Co., Inc., 1980.

2. Kormondy, Edward J. and Bernice E. Essenfeld. Addison-Wesley Biology. First edition. Don Mills, ON: Addison-Wesley Publishing Co., 1984.

3. Kaskel, Albert, et al. Laboratory Biology: Investigating Living Systems. Columbus, OH: Charles E. Merrill Publishing Co., 1983.

TEACHER REERENCES:

* 1. OISE. Population Problems. Toronto, ON: OISE Press, 1980.

2. Miller, G. Tyler, Jr. Living in the Environment. Third edition. Belmont, CA: Wadsworth Publishing Co., 1982.

3. Volpe, Peter E. Biology and Human Concerns. Third edition. Dubuque, IA: Wm. C. Brown Co., 1983.

4. Slesnick, Irwin H., et al. Biology. Glenview, IL: Scott Foresman and Co., 1980.

* This reference is very useful.

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
The student should be able to:		
1.0 Define the term population.		Addison-Wesley Biology: Chapter 23, "Populations in Ecosystem." Biology: The Science of Life: Chapter 14, "Food Chains and Webs."
2.0 Describe characteristics of a population, e.g., - density - mortality - natality - age ratio - sex ratio - migration	Develop a worksheet on densities of populations in a given area. Play simulation game, "Extinction," available through Caroline Labortory Supplies. Plan population survey.	Addison-Wesley Biology: Laboratory Manual: Experiment 57, "A Predator-Prey Simulation." Biology and Human Concerns: Chapter 42, "Population Dynamics." Laboratory Biology: Investigating Living Systems: Lab 75-A, "A Yeast Population Study." Biology: The Science of Life: Chapter 15, "Control of Population Growth."
2.1 Describe the features of a population growth curve.	Conduct a biological population study. Compare different kinds of growth curves.	Addison-Wesley Biology: Laboratory Manual: Experiment 58, "Population Growth." Biology and Human Concerns: Chapter 42, "Population Dynamics."
2.2 Compare how arithmetic and geometric progressions relate to population growth.		Biology: The Science of Life: Chapter 15, "Control of Population Growth."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
2.3 Describe how natural populations maintain homeostasis.		Biology: The Science of Life: Chapter 15, "Homeostasis in Natural Populations."
3.0 Describe interrelationships between populations using the following terms: - symbiosis - mutualism - parasitism - commensalism - competition - predation	Do a predatory-prey simulation using coloured beans. Predation and litter sizes are altered in the game.	Biology: The Science of Life: Chapter 4, "Symbosis." Addison-Wesley Biology: Chapter 1, "The World of Life." Biology and Human Concerns: Chapter 44, "Interaction of Populations." Biology: The Science of Life: Chapter 4, "Symbiosis."
4.0 List the stages of human population growth.	Research population growth trends both globally and in local towns and cities.	Biology: The Science of Life: Chapter 16, "History of the Problem." Biology and Human Concerns: Chapter 42, "Population Dynamics"; Chapter 43, "Prevalence of People." Biology: The Science of Life: Chapter 16, "Natural Resources and the Human Population." Living in the Environment: Part 3, "Population, Resources and Pollution."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
4.1 Describe the environmental problems related to the overpopulation of humans.	View film, "Say Goodbye," available through Wolpner Productions. View film, "Cry of the Marsh," available through Synder Productions. View audio filmstrip, "Case of the Bighorn Sheep," available through Warren Schloat Productions.	Biology: The Science of Life: Chapter 16, "Pollution and the Standard of Living"; Chapter 13, "The Cycles in the Industrialized World"; Chapter 14, "Pollution and Food Chains." Biology and Human Concerns: Chapter 43, "Prevalence of People." Living in the Environment: Unit 5, "Enrichment Studies."
4.2 Identify possible solutions to the problem of human overpopulation, e.g., - economic incentives - education programs - selective eugenics - lifeboat scenario	Discuss the pros, cons and implications of implementing any or all of the proposed solutions. The Ethical Probe 24, "Lifeboat Ethics," from Biology and Human Concerns can be used to introduce the topic.	

OPTION D: TITLE: Environmental Issues TIME: 10 hours

RATIONALE: This unit, Environmental Issues, provides the student with the opportunity to apply his or her previously acquired knowledge about ecology to a particular contemporary environmental problem. In this option unit, the student is presented with a particular environmental crisis, one that directly affects his or her wellbeing. The student is totally immersed in all aspects of the controversy and is asked to give a solution to the problem through a decision-making process. Since the outline for this option unit is only general, teachers should consult the sample unit, The Garrison Diversion Project, for more complete instructions.

TEACHER REFERENCES:

1. The Garrison Diversion: An Environmental Issue (a kit), The Department of Natural Resources, 1485 St. James Street, Winnipeg.

2. Garrison Diversion: Opposing Views (information sheets), Garrison Found, The Department of Natural Resources, 41 Legislative Building, Winnipeg.

3. Saskatchewan Environment. Wetland's Management Case Study (a kit), Western Extension College Educational Publishers, Saskatoon, 1978.

4. Marlon, John, et al. Issues for Today: Canadian Environmental Concerns. Agincourt, ON: GLC Silver Burdett, 1985.

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
The student should be able to:		
1.0 Describe the historical development of a particular environmentally related issue.	Identify an environmental issue of personal concern. Take pre-tests designed to assess knowledge about and attitudes toward selected issues. Gather information related to the issue.	Sample Unit: The Garrison Diversion Project

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
2.0 List advantages and disadvantages related to a particular project or environmental problem.	Organize and evaluate the relevance and source of the information gathered.	Garrison Diversion Project
3.0 Select and organize information perceived pertinent to the issue.	Prepare to defend a position with respect to the issue.	Garrison Diversion Project
4.0 Clearly state and defend their positions on the project or problem based on the evidence presented.	Engage in a debate with students holding opposing views.	Garrison Diversion Project
5.0 Evaluate proposed solutions to the project or problem.	Assess the feasibility of solutions based on decisions.	

SAMPLE UNIT: THE GARRISON DIVERSION PROJECT

The Garrison diversion project is an example of an important environmental issue in the province of Manitoba. As natural resources, such as fresh water, become scarce, more national and international environmental confrontations will occur. In this sample option, students are presented with an environmental crisis that directly affects their wellbeing. Exposure of the student to all aspects of the controversy provides the opportunity to attempt to resolve the problem through a decision-making process which includes determining the critical factors which affect an issue and to research relevant data.

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
The student should be able to:		
1.0 Identify the Garrison diversion project as an irrigation project.	Administer pre-attitudinal and/or pre-cognitive survey. Identify the major participants in the project.	"The Garrison Diversion: An Environmental Issue," a resource kit consisting of overhead transparencies simulations, audio-visual presentation survey, bibliography, and tests, available through the Department of Natural Resources, 1485 St. James Street.
2.0 Describe the historical events leading to the proposed Garrison diversion project.	Study historical events in North Dakota from 1887 to 1982. Establish need of water in agriculture.	
3.0 Locate the geographical sites involved in the Garrison diversion project.	Present a map study showing the pre-Garrison and post-Garrison geography. Explain drainage systems and significnce of the continental divide.	
4.0 Identify the political, legal, economic and environmental factors related to the Garrison diversion project.	Review border laws and regulations.	"Water: A Billion Dollar Battle Ground", Time (April 4, 1977). Josephy, Alvin M., Jr., Or Strange Love Builds a Canal, Audubon 77(2): 76, 1975.

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
5.0 List the advantages of the Garrison diversion project.	Emphasize the need for water in a dry region, e.g., Oakes County.	
5.1 List the disadvantages of the Garrison diversion project.	Show adverse effects of project to Manitobans and South Dakotans.	Audio - 35-mm slide presentations are available from the Four Nation's Confederacy or Water Resources Probe.
5.2 Discuss the feasibility of the Garrison diverison project.	Try parallel study using a simulation game. Determine and research critical data concerning pros and cons.	The Burlington Dam Debate: An Environmental Simulation Game (available from Manitoba Education Library).
5.3 State and defend their position on the Garrison diversion project based on evidence presented.	Try to establish position based on all previous information.	The Story of Water: The Garrison Diversion Project (kit available from Manitoba Education Library).
5.4 Discuss possible solutions to the Garrison diversion project.	Consider the questions: Is there a Manitoba solution? A North Dakota solution? Priorize potential solutions on the basis of criteria acceptable to the group. Students should become aware that the importance of criteria will vary according to the group.	Swinerton E. Nelson, The Dead River: A Simulation Game of River Restoration. Opposing Views (a package of articles including recommendations from J.C.E., available from Garrison Focus Office, 41A Legislative Building).

OPTION E: TITLE: Heart Health TIME: 6 hours

RATIONALE: Though there has been a recent downward trend in the rate of death caused by coronary heart disease, it is still a major cause of death in Canada. The fact ought to be a concern to members of our society, in view of the economic and social costs associated with heart disease. This option unit has been included for the Biology 200 program in order to give students a basic understanding of heart disease and to show that heart disease can be controlled by controlling lifestyle.

PRIMARY REFERENCES:

*1. Rahn, Joan. Biology: The Science of Life. Second edition. New York: Macmillan Publishing Co., Inc., 1980.

OR

*2. Berry, Gordon S., et al. Biology of Ourselves: A Study of Human Biology. Toronto: John Wiley and Sons, 1982.

3. Kormondy, Edward J. and Bernice E. Essenfeld. Addison-Wesley Biology. First edition. Don Mills, ON: Addison-Wesley Publishing Co., 1984.

TEACHER REFERENCES:

1. Fisher, Arthur. The Healthy Heart. Time-Life Books, 1981.

2. "Heart Attack Signals: Desperate Hours for the Body," Sciquest, vol. 53, no. 8 (October 1980).

3. DeCoursey, R.M. and J.L. Renfro. The Human Organism. Fifth edition. Toronto: McGraw-Hill Book Co., 1980.

OR

4. Scarrow, Hart R. Bodyworks: Your Human Biology. Toronto: Globe/Modern Curriculum Press, 1979.

*A single copy of Fisher, Arthur, The Healthy Heart, would be very useful in supporting this unit.

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
The student should be able to:		
1.0 Name the organs of the cardiovascular system and discuss their functions.	Review, as necessary, from material in Unit IV (Transport System).	See Unit IV (Transport System). Addison-Wesley Biology: Teachers' Supplement, Unit 2.
1.1 Name and locate the major parts of the heart and discuss the functions of each part.		
1.2 Trace the pathway of blood through the heart and the vessels of the coronary circulation.		
1.3 Discuss the cardiac cycle and explain how it is controlled.		
2.0 Identify the components of a normal ECG pattern and relate these to the events of the heartbeat.	Examine ECG samples, if available, or use illustrations from references and correlate the components of the graph to heart action.	The Healthy Heart: Chapter 4, "A Spectrum of Ills and Remedies." Biology of Ourselves: A Study of Human Biology: Chapter 10, "The Heart and Circulation of the Blood." The Human Organism: Chapter 15, "The Heart, the General Circulation, and the Lymphatic System."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
2.1 Define and describe cardiac arrhythmia.		The Healthy Heart: "An Encyclopedia of Symptoms."
3.0 Describe the nature of a heart attack and why it occurs.		The Healthy Heart: Chapters 4 and 5. Sciquest, "Heart Attack Signals: Desperate Hours for the Body" (October 1980).
3.1 Describe the risk factors for cardiovascular disease and how they affect individuals.	Discuss the following risk factors: - elevated blood fat levels - psycho-social stress and personality - hereditary factors - contraceptive pills - diabetes - cigarette smoking - inflammations and infections - elevated uric acid in the blood - overweight - lack of exercise	"Risk Factors and Coronary Disease: A Statement for Physicians," reprint from Circulation (62:445a, 1980). The Healthy Heart: Chapter 2, "How Not to Get Heart Disease"; Chapter 3, "Tracking Down the Cholesterol Connection."
4.0 List and explain the known effects of exercise on the function of the heart and circulation.	Do the Canadian Fitness Test. Do lab to illustrate the effects of exercise on heart activity.	Bodyworks: Your Human Biology: Lab 7-D, "Your Heart and Exercise."
4.1 Describe how blood pressure is created and controlled.	Do lab to illustrate effects of exercise on blood pressure.	Biology of Ourselves: A Study of Human Biology: Chapter 10, Activity 3, "Blood Pressure."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
		Bodyworks: Your Human Biology: Lab 7-C, "Blood Pressure and Exercise."
4.2 Name the signals for a heart attack and indicate what they may mean.	Do a case study of a heart attack victim.	Biology of Ourselves: A Study of Human Biology: Chapter 10, "The Heart and Circulation of the Blood." The Healthy Heart: Chapter 4, "An Encyclopedia of Symptoms." Sciquest, "Heart Attack Signals: Desperate Hours for the Body."
4.3 List the emergency actions that can be taken in case of a cardiac arrest.	Have a qualified instructor conduct a CPR course with the students.	The Healthy Heart: Chapter 4, "A Spectrum of Ills and Remedies."
5.0 Describe the causes and effects of the various cardiovascular diseases.	Discuss such conditions as stroke, atherosclerosis, ischemic heart disease, aneurysm, angina, pectoris, coronary thrombosis, fibrillation, murmurs.	Biology of Ourselves: A Study of Human Biology: Chapter 10, "The Heart and Circulation of the Blood." The Human Organism: Chapter 15, "The Heart, the General Circulation and the Lymphatic System."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
5.1 Describe the various surgical techniques available today for prolonged heart life and health.	Discuss the role of the pacemaker, artificial valves, by-pass surgery and heart transplants in the treatment of heart disease.	The Healthy Heart: Chapter 5, "Newfound Prowess of the Surgeon"; Chapter 6, "How to Get Over a Broken Heart."

OPTION F: TITLE: Human Behaviour TIME: 10 hours

RATIONALE: This unit, Human Behaviour, is a natural extension of the unit on the nervous system presented in the grade eleven biology program. Students live in a complex society in which they are confronted with many social pressures. Success for an individual in our society is often measured by how effectively that individual interacts with others. An understanding of basic human psychology may help students deal with the stressful situations they are confronted with and may help prepare them for their personal future endeavours.

PRIMARY REFERENCES:

1. Berry, Gordon S. Biology of Ourselves: A Study of Human Biology. Toronto: John Wiley and Sons, 1982.

2. Rahn, Joan E. Biology: The Science of Life. Second edition. New York: Macmillan Publishing Co., Inc., 1980.

3. Kormondy, Edward J. and Bernice E. Essenfeld. Addison-Wesley Biology. First edition. Don Mills, ON: Addison-Wesley Publishing Co., 1984.

4. Wrightsman, Laurence S., et al. Psychology: A Scientific Study of Human Behaviour. Monterey, CA: Brooks/Cole Publishing Co., 1979.

SECONDARY REFERENCES:

1. BSCS Blue Version. Biological Science: A Molecular Approach. Boulder, CO: D.C. Heath and Co., 1985.

2. BSCS Yellow Version. Biological Science: An Inquiry into Life. New York: Harcourt Brace Jovanovich, 1980.

TEACHER REFERENCES:

1. BSCS. Biological Science: Interaction of Experiments and Ideas. Third edition. Englewood Cliffs, NJ: Prentice-Hall, Inc.

2. Packard, Vance. The Hidden Persuaders. New York: Simon and Schuster, 1972.

3. Buying and Selling (ISIS Module). Lexington, MA: Ginn and Co., 1980.

4. Volpe, Peter K. Biology and Human Concerns. Third edition. Dubuque, IA: Wm. C. Brown Co., 1983.

5. "The Nature and Nurture of Behaviour," Readings from Scientific American. San Francisco: W.H. Freeman and Co., 1973.

6. "Psychology, The Biological Bases of Behaviour," Scientific American. San Francisco: W.H. Freeman and Co., 1973.

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
The student should be able to:		
1.0 Identify examples of innate behaviour.	Demonstrate simple reflex activities--blinking, knee-jerking, blushing, salivating, in humans.	Addison-Wesley Biology: Chapter 25, "Behavior." Biological Science: An Inquiry into Life: Chapter 22, "Animal Behaviour." Biology and Human Concerns: Chapter 11, "Co-ordination by Nerves." Biology: The Science of Life: Chapter 36, "The Nervous System and Co-ordination." Laboratory Biology: Investigating Living Systems: Lab 74, "Earthworm Behaviour." Biological Science: An Inquiry into Life: Inquiry 22-3, "Reflexes in Humans."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
1.1 Identify various types of learned behaviour (conditioning, habituation, imprinting, trial-and-error, reasoning).	Construct finger mazes for trial and error learning. Conduct memorization activity with nonesense syllables.	Psychology: A Scientific Study of Human Behaviour: Chapter 7, "Learning and Memory." Biological Science: Interaction of Experiments and Ideas: Investigation 7-7, "Imprinting Learning." Biology of Ourselves: A Study of Human Biology: Chapter 6, "The Nervous System." Biological Science: An Inquiry into Life: Chapter 22, "Learning."
1.2 Compare innate and learned behaviour.	Do a lab study of behaviour of a caterpillar, earthworm and/or meal worm.	Biology and Human Concerns: Chapter 49, "Ethology: The Comparative Study of Behavior." Biological Science: An Inquiry into Life: Inquiry 22-4, "Behaviour of a Caterpillar," Chapter 22, "Volution of Behaviour." Biological Science: A Molecular Approach: Chapter 24, "The Organism and Behaviour."
2.0 Identify psychological drives and needs.		Psychology: A Scientific Study of Human Behaviour: Chapter 10, "Motivation."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
3.0 Identify individual differences in visual perception.	Do a survey of individual differences in the perception of visual images that have dual interpretations. Make up a series of overheads from Scientific American to survey student perceptions.	Biological Science: Interaction of Experiments and Ideas: Chapter 3, "Development of Perception." Scientific American, vol. 225, no. 6 (December 11, 1958), p. 63. Psychology: A Scientific Study of Human Behaviour: Chapter 6, "Sensation and Perception."
4.0 Apply principles of human psychology to consumer marketing.	Visit a supermarket and determine how consumer psychology has been applied in terms of: - music - shelf position - bargain specials - packaging - displays - decor - check-out items	The Hidden Persuaders Buying and Selling (ISIS)
5.0 Describe various examples of verbal and non-verbal communication.	Do a survey of space bubbles in public places.	Biology and Human Concerns: Chapter 49, "Ethology: The Comparative Study of Behavior." Psychology: A Scientific Study of Human Behaviour: Chapter 8, "Communication and Thought."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
6.0 Describe various human behavioural disorders, e.g., - schizophrenia - depression - phobias - annorexia - psychoses - neuroses		Biology of Ourselves: A Study of Human Biology: Chapter 15, "Case Study." Psychology: A Scientific Study of Human Behaviour: Chapter 15, "Psychological Disorders"; Chapter 16, "Prevention and Treatment of Psychological Disorders."
6.1 Discuss behaviour modification as a method of treatment and a method of conditioning (brainwashing).		
7.0 List trends in current research in human psychology.		Psychology: A Scientific Study of Human Behaviour: Chapter 17, "Brave New Worlds."

OPTION G: TITLE: Aging TIME: 10 hours

RATIONALE: Although the life span may vary from a few days to thousands of years among different species, all organisms, from simple to complex, experience an aging process that eventually results in death. This unit explores the process of aging in humans, discusses disorders associated with aging, how lifestyle can affect longevity, and addresses some of the psychological and sociological aspects of aging in our society.

SECONDARY REFERENCES:

1. Zarit, S.H. Readings in Aging and Death: Contemporary Perspectives. New York: Harper and Row, 1977.

2. Lewis, John L. Medicine and Care. London: Heinemann Eductional Books Ltd., 1981. (Canadian representative: Book Society of Canada Ltd., Agincourt, ON.)

TEACHER REFERENCE:

1. Barman, Charles R., et al. Science and Societal Issues. Ames, IA: The Iowa State University Press.

2. Volpe, Peter E. Biology and Human Concerns. Third edition. Dubuque, IA: Wm. C. Brown Co., 1983.

3. Bullock, Barbara L. Pathophysiology Adaptation and Alternations in Function. Toronto: Little, Brown and Co., 1984.

4. Kastenbaum, Robert. "Growing Old: Years of Fulfillment." Part of Life Cycle Series, Harper and Row, 1980.

5. Fitzgerald, Hiram E., and Michael Wolveven. Human Development. Annual addition series, Dushkin Publishers, 1984-85.

AUDIO-VISUAL REFERENCES:

Films

1. Family Relationships - Case Studies. Page 1973, 28 minutes, colour, HQ 1061.
2. Biological Changes of Aging: Function and Capacity, QP 86.355.
3. Biological Changes of Aging: Physical Appearance and their Special Senses, QP 85 B56.
4. The Challenge of Aging: Change and Loss, 1 + 2, 1061 C43.
5. Human Sexuality with Aging, QP 86 H85, Trainex Corporation, film strip and sound cassette, 20-30 minutes, colour, 1976.

Available from Department of Health and Social Development

6. Aging, 14 minutes, colour (three patterns of aging).
7. Art of Age, 27 minutes, colour (stresses productivity of age).
8. Portrait of Louise Tandy March, 24 minutes, colour (a strong, gentle film on love of life).
9. Priory Method, 20 minutes, colour (a method of preventing dependence in hospitals).

Printed Material

1. Hess, Beth B. Aging and Old Age. Macmillan, 1980.
2. Hendricks, J. and C. Davis Hendricks. Aging in Mass Society: Myths and Realities. Second edition. Boston, MA: Little, Brown and Co., 1981.

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
The student should be able to:		
1.0 Describe the biological, sociological and psychological aspects of human aging.		Science and Societal Issues: Chapter 13, "Aging: The Last Frontier of Life." Readings in Aging and Death: Contemporary Perspectives: No. 3, "Successful Aging and the Role of the Life Review"; No. 6, "Normal Aging." L.R. Krupka and A.M. Vener, "Treatment of Aging in Secondary School Biology Textbook: A Neglected Phenomenon," American Biology Teacher, vol. 44, no. 5 (1982).
2.0 Compare the aging process in unicellular and multicellular organisms.		Biology and Human Concerns: Chapter 16, "Aging and Death." Readings in Aging and Death: Contemporary Perspectives: No. 7, "A New Age for Aging."
3.0 Describe aging related diseases and disorders, e.g., progeria, arteriosclerosis, senile dementia.		Man, Nature and Society: An Introduction to Biology: Chapter 16, "Aging and Death."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
		Readings in Aging and Death: Contemporary Perspectives: No. 8, "Physiology of Exercise and Aging."
4.0 Describe individuals and communities with extended life spans.	Conduct a student pictorial survey assignment. Have students arrange snapshots chronologically of a number of people for aging examination.	Man, Nature and Society: An Introduction to Biology: Chapter 6, "Aging and Death." Readings in Aging and Death: Contemporary Perspectives: No. 39, "Why They Live to Be 100, or Even Older, in Abkhasia."
4.1 Relate lifestyle to longevity.		Pathophysiology: Chapter 4.
5.0 Identify the emphasis of current research in gerontology.	Conduct a review of current literature on the subject of aging.	Man, Nature and Society: An Introduction to Biology: Chapter 16, "Aging and Death." Readings in Aging and Death: Contemporary Perspectives: No. 2, "Gerontology--Getting Better All the Time"; No. 7, "A New Age for Aging."
5.1 Investigate the psychological and sociological aspects of aging.	Organize a classroom visit and interview occupants of a senior citizens' home.	

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
6.0 List the advantages and disadvantages of having a large number of post-reproductive members in our society.		Readings in Aging and Death: Contemporary Perspectives: No. 22, "Income and Health Care of the Aging." Medicine and Care: Unit 6, "Care of the Elderly."
EXTENSIONS		
Euthanasia		Medicine and Care: "Euthanasia."
1.0 Identify and evaluate the pros and cons of euthanasia.		Readings in Aging and Death: Contemporary Perspectives: No. 55, "A Right to Die." Medicine and Care: Unit 6, "Care of the Elderly." Science and Societal Issues: Chapter 9, "Activities."

OPTION H: TITLE: Disease-Causing Organisms in Humans TIME: 10 hours

RATIONALE: The homeostatic balance of the human body may be disturbed by the invasion of a number of different types of organisms. In this unit the student is introduced to those organisms which commonly invade the human body. The emphasis in this unit should be the development and maintenance of a lifestyle which precludes infection by these organisms.

PRIMARY REFERENCES:

1. Rahn, Joan E. Biology: The Science of Life. Second edition. New York: Macmillan Publishing Co., Inc., 1980.

2. Kormondy, Edward J, and Bernice E. Essenfeld. Addison-Weslely Biology. First edition. Don Mills, ON: Addison-Wesley Publishing Co., 1984.

SECONDARY REFERENCES:

1. Kingsley, V. Basic Microbiology for the Health Sciences. Toronto: Saunders Co., 1982.

2. BSCS Yellow Version. Biological Science: An Inquiry into Life. New York: Harcourt Brace Jovanovich, 1980.

TEACHER REFERENCES:

1. Smith, Alice L. Microbiology and Pathology. Twelfth edition. St. Louis: C.V. Mosby, 1980.

2. Smith, Alice L. Microbiology Laboratory Manual and Workbook. Fifth edition. St. Louis: C.V. Mosby, 1981.

3. Carpenter, P. Microbiology. Fourth edition. Philadelphia: W.B. Saunders, 1977.

4. Volpe, Peter E. Biology and Human Concerns. Third edition. Dubuque, IA: Wm. C. Brown Co., 1983.

5. Raphael, Stanley S. Lynch's Medical Laboratory Technology. Toronto: Sanders Co., 1983.

6. Edmonds, Paul. Microbiology: An Environmental Perspective. New York: Macmillan Publishing Co., Inc., 1983.

7. Bullock, Barbara L. Pathophysiology. Toronto: Little, Brown and Co., 1984.

8. Slesnick, Irwin H. Biology. Glenview, Illinois: Scott Foresman and Co., 1985.

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
The student should be able to:		
1.0 Describe the morphology of bacteria.		Addison-Wesley Biology: Chapter 26, "Health and Disease." Basic Microbiology for the Health Sciences: Chapter 4, "The Classification, Isolation, and Characterization of Bacteria." Biological Science: An Introductory Study: "Monerans and Viruses."
1.1 List the shapes and grouping of bacteria.	Examine prepared slides or diagrams of bacteria.	Biology: The Science of Life: Chapter 2, "Naming and Classification of Living Things."
1.2 Discuss factors related to bacterial growth.	Grow a bacterial culture.	Microbiology and Pathology: Unit 2, "Microbes: Procedures for Study."
1.3 Describe two ways in which bacteria causes disease.		Basic Microbiology for the Health Sciences: Chapter 1. Microbiology and Pathology: Unit 3," "Microbes: Production of Infection.
1.4 Describe the symptoms, transmission and treatment of some common communicable diseases.	Discuss: - pneumonia - tuberculosis - tetanus	Microbiology and Pathology: Chapter 48, "Diseases of Respiratory Tract." Pathophysiology: Chapter 7. Microbiology: An Environmental Perspective: Chapter 8.

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
1.5 Describe defences against bacterial disease made by humans.	Discuss the composition, action, and use of: - antibiotics - disinfectants - vaccines	Basic Microbiology: Chapter 5. Biology: The Science of Life: Chapter 44, "Resistance to Antibiotics." Microbiology and Pathology: Unit 6, "Microbes: Public Welfare"; Unit 4, "Microbes: Preclusions of Disease."
Viruses The student should be able to:		
1.0 Describe and diagram the life cycle of a virus.		Microbiology and Pathology: Chapter 26, "Viruses"; Chapter 27, "Viral Diseases."
2.0 Describe the symptoms, transmission and treatment of selected viral diseases.	Discuss smallpox, hepatitis, polio, herpes and the common cold.	Microbiology and Pathology: Chapter 27, "Viral Diseases." Microbiology: An Environmental Perspective: Chapter 1. Pathophysiology: Chapter 7. Basic Microbiology: Chapter 2. Pathophysiology: Chapter 22.

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
3.0 Discuss the nature of body defences against viral diseases.		
Parasites		
The student should be able to:		
1.0 Define the terms: - ectoparasites - endoparasites		
2.0 Describe the transmission of an endoparasite (Plasmodium sp.).		
2.1 Describe the transmission of an ectoparasite.		
3.0 Discuss methods of eradicating these parasites.		
Fungi		
The student should be able to:		
1.0 Describe fungi that may cause human disease.	Discuss fungal infestations, e.g., moniliasis, athlete's foot, ring worm.	
2.0 Discuss the transmission of human diseases caused by fungi.	Discuss the influence of lifestyle on the spread of fungal infections.	Pathophysiology: Chapter 7.

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
3.0 Discuss methods of preventing and curing human diseases caused by fungi.		Microbiology: An Environmental Perspective: Chapter 8.
Immunity The student should be able to:		
1.0 Discuss the body's defence against disease causing organisms.	Discuss the role of the following in body defence. - skin and mucous membranes - cellular defences - antigens and antibodies Discuss artificial immunity in terms of: - purpose - materials used - precautions - diseases for which it is available Examine specimens of or literature pertaining to biological materials. Visit the local health unit.	Biology: The Science of Life: Chapter 34, "The Lymph System." Microbiology and Pathology: Chapter 19, "The Body's Defense." Microbiology: Chapter 6, "Immunology"; Chapter 7, "Infectious Diseases."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
Epidemiology		
The student should be able to:		
1.0 Discuss the transmission of disease.	Trace the pathway of transmission of selected diseases, e.g., tapeworm, malaria, tuberculosis, plague, typhus, typhoid, STD, and rabies.	Microbiology and Pathology: Chapter 8, "Role in Disease." Microbiology: Chapter 23, "Ecology of Infectious Disease." Film: "An Outbreak of Salmonella." Microbiology: An Environmental Perspective: Chapter 8.
2.0 Discuss ways in which transmission may be controlled.		
3.0 Discuss the responsibility of the individual and the society for the prevention of transmission of disease.	Research the incidence of specific diseases and their relation to the history and economics of the country.	
4.0 Relate the incidence of communicable disease to the economic welfare of a country.	Research the history of a specific epidemiologist, e.g., Pasteur.	

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
Effects of Isolation The student should be able to: 1.0 Discuss the relationship between the incidence and virulence of disease and the isolation of the individual or community.	Research the effects of isolation on the type and severity of a communicable disease found in a community. Discuss the effects of travel on the spread of communicable disease, e.g., dysentery, malaria. Describe methods whereby persons with infectious diseases may be isolated to prevent spreading the diseases.	Microbiology and Pathology: Chapter 15, "Practical Techniques"; Chapter 8, "Role in Disease."

OPTION I: TITLE: Sexually Transmitted Diseases (STDs)

RATIONALE: Sexually transmitted diseases are a major health problem in North America. During the past decade, the number of cases, especially in high-school populations, has reached epidemic proportions. STDs are cause for great concern among the victims, families, health professionals, health care agencies, and indeed for society in general. Recently there has been a widespread escalation of STDs in the nation. However, public attitudes appear to have disregarded the evidence: many people regard STDs as not serious and easily treated. Providing educational programs such as this unit, especially directed at high school students, is one way of trying to educate the public and trying to present the rising incidence of STDs. This unit discusses the multi-causal factors relating the host, behaviour and environment to disease agents. It also discusses how risk factors can be controlled or avoided in order to reduce or eliminate the spread of the STDs.

PRIMARY REFERENCES:

1. Berry, Gordon S. Biology of Ourselves: A Study of Human Biology. Toronto: John Wiley and Sons, 1982.

2. Rahn, Joan E. Biology: The Science of Life. Second edition. New York: Macmillan Publishing Co., Inc., 1980.

TEACHER REFERENCES:

1. Purtilo, David T. A Survey of Human Diseases. Don Mills, ON: Addison-Wesley Publishing Co., 1980.

2. Smith, Alice L. Microbiology and Pathology. Twelfth edition. St. Louis: C.V. Mosby, 1977.

3. Beishir, L. Microbiology in Practice. San Francisco: Canfield Press, 1974.

4. Fassbender, W. You and Your Health. Second edition. Toronto: John Wiley, 1981.

5. Julian, C.J., N. Jackson and N.S. Smith. Modern Sex Education. Toronto: Holt, Rinehart and Winston, 1980.

6. Pollock, M.B., C.O. Purdy and C.R. Carroll. Health, A Way of Life. Glenview, Illinois: Scott Foresman, 1979.

7. Robertson, A., G. Mutter, J. Sanders and R. Smith. Decisions for Health. Scarborough: Nelson Canada Limited, 1981.

8. Bicher, M., D. Cherniak, A. Feingold and S. Gardiner. VD Handbook. Third edition. Montreal: Montreal Health Press, 1975. (free)

9. Riker, A. and C. Riker. Finding My Way. Peoria, Illinois: Charles A. Bennett, 1979.

10. Painter, John H. Life and Health. Del Mar, California: CRM Ziff-Davis Publishing Company, 1972.

11. Meeks, Linda and Phillip Heit. Health Focus on You: Venereal Diseases--Sexually Transmitted Diseases. Toronto: C.E. Merrill Publishing Co., 1982.

12. Venereal Disease Education: Teacher Resources. Columbus, Ohio: Department of Health and Ohio Department of Eduation, 1976.

13. STD: Genital Herpes, STD, STD: Non-Gonococcal Urethritis, available from Manitoba Health, Winnipeg.

Films (Available from Manitoba Education):

The Silent Epidemic
A Million Teenagers
The Hidden Epidemic
The Invaders

VD: Twentieth Century Plague (kit)
Marsh Film Enterprises, 1975.

Filmstrips and cassettes (1982) (Available from: Sunburst Communications, 39 Washington Avenue, Pleasantville, New York 10570, telephone 800-431-1934):

Sexually Transmitted Diseases
How You Get VD
Herpes

Pamphlets:

VD: What You Don't Know Can Hurt You (Available from the Department of Health and Community Services, 880 Portage Avenue, Winnipeg, Manitoba)

Sexually Transmitted Diseases (Available from Health and Welfare Canada, Ottawa, Ontario)

Slides and Transcripts:

VD (Available from Spenco Medical Corporation, P.O. Box 8113, Waco, Texas 76710)

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
The student should be able to:		
1.0 Distinguish between bacteria, fungi, viruses and protozoa.	Examine slides, photographs and cultures of representative microorganisms.	Health Focus on You: Venereal Diseases--Sexually Transmitted Diseases: Chapters 2-8, "Gonorrhea," "Pediculosis."
1.1 Describe the symptoms and causative agents of: genital herpes, syphilis, gonorrhea, trichomoniasis, nonspecific urethritis, Candida albicans vaginitis.	Examine slides and photographs of appropriate material.	VD Handbook: Chapter 2.
1.2 Describe the diagnosis, treatment and prevention of STDs.	Show the importance of early diagnosis and correct medical treatment.	
1.3 Explain the epidemiology of STDs.		

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
1.4 Describe the pre-, peri- and postnatal effects of STDs.		
2.0 Explain the legal and moral implications of STDs.		
3.0 Describe the symptoms, causative agent and treatment of pubic lice.		

OPTION J: TITLE: Support and Movement TIME: 10 hours

RATIONALE: Participation in a wide variety of physical activities adds greatly to the full enjoyment of life in any individual. A decrease in the level of physical activity often leads to negative emotional changes. In view of this, it is helpful for students to study the systems that give humans mobility. In this unit, students are made aware of those factors which can be controlled in order to keep these systems functioning at their optimum efficiency for as many years as possible. This unit also discusses the skin in terms of defence, excretion, receptivity and homeostasis. The student is made aware of the ways in which he or she can maintain the skin so that these functions are accomplished with maximum efficiency.

PRIMARY REFERENCES:

1. * Berry, Gordon S. Biology of Ourselves: A Study of Human Biology. Toronto: John Wiley and Sons, 1982.

2. Rahn, Joan E. Biology: The Science of Life. Second edition. New York: Macmillan Publishing Co., Inc., 1980.

3. Kormondy, Edward J., and Bernice E. Essenfeld. Addison-Wesley Biology. First edition. Don Mills, ON: Addison-Wesley Publishing Co., 1984.

4. Kaskel, Albert, et al. Laboratory Biology: Investigating Living Systems. Columbus, OH: Charles E. Merrill Publishing Co., 1983.

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1. BSCS Blue Version. Biological Science: A Molecular Approach. Boulder, CO: D.C. Health and Co., 1980.

2. BSCS Yellow Version. Biological Science: An Inquiry into Life. New York: Harcourt Brace Jovanovich, 1980.

TEACHER REFERENCES:

1. Evans, Williams F. Anatomy and Physiology. Third edition. New Jersey: Prentice-Hall Inc., 1983.

2. Volpe, E. Peter. Biology and Human Concerns. Third edition. Dubuque, IA: Wm. C. Brown Co., 1983.

3. Purtilo, David T. A Survey of Human Diseases. Don Mills, ON: Addison-Wesley Publishing Co.

4. Cornett, F.D. and Pauline Gratz. Modern Humen Physiology. Toronto: Holt, Rinehart and Winston, 1982.

5. Cornett, F.D. and Pauline Gratz. Experiments in Modern Human Physiology. Toronto: Holt, Rinehart and Winston, 1982.

6. Slesnick, Irwin H., et al. Biology. Glenview, Illinois: Scott Foresman and Co., 1985.

7. Scarrow, Hart R. Bodyworks: Your Human Biology. Toronto: Globe/Modern Curriculum Press, 1979.

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
The student should be able to:		
1.0 Identify the layers and structures that comprise the skin.	Examine microslides of skin tissue.	Addison-Wesley Biology: Chapter 10, "Excretion." Biology of Ourselves: A Study of Human Biology, Chapter 3, Activity 6, "An Exercise in Observation." Biology: The Science of Life: Chapter 39, "The Integumentary System." Bodyworks: Your Human Biology: Chapter 3, Lab A, "Skin Patterns."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
1.1 State and test the functions of the skin layers and their associated structures.	Do a lab to examine surface structures of the skin.	Biology of Ourselves: A Study of Human Biology: Chapter 3, Activity 6, "An Exercise in Observation." Biology: The Science of Life: Chapter 39, "The Integumentary System." Bodyworks: Your Human Biology: Chapter 3, Lab A, "Skin Patterns."
2.0 Explain the role of the skin as an excretory organ.	Do a lab to identify sweat glands.	Biology of Ourselves: A Study of Human Biology: Chapter 3, Activity 8, "Distribution of Sweat Glands on the Surface of the Skin." Bodyworks: Your Human Biology: Chapter 3, Lab C, "Sweat Glands."
3.0 Explain the role of the skin as a receptor of environmental stimuli.	Do labs on testing for the presence of various receptors for temperature, pain, pressure and touch.	Biology of Ourselves: A Study of Human Biology: Chapter 3, Activity 1, "Temperature"; Activity 2, "Pain and Pressure"; Activity 3, "Tactile Discrimination"; Activity 4, "Two Point Sensitivity"; Activity 5, "What Stimuli are Required to Recognize Differences in Similar Objects"; Activity 7, "Temperature Stimulation."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
4.0 Discuss the homeostatic mechanisms related to the integumentary system.	Do a lab on the role of the skin in temperature regulation.	Biology of Ourselves: A Study in Human Biology: Chapter 3, Activity 9, "The Effect of Exercise on Body Temperature." Bodyworks: Your Human Biology: Chapter 3, Lab D, "Body Temperature."
5.0 Describe the structure of the skeleton.		
5.1 Describe the nature of cartilage, bone and white fibrous connective tissue.	Examine a fresh long bone. Determine the chemical composition of bones. Examine prepared slides of tissues.	Bodyworks: Your Human Biology: Chapter 4, Unit D, "Bone Structure." Biology of Ourselves: A Study of Human Biology: Chapter 4, "Bones and Joints." Addison-Wesley Biology: Chapter 11, "Movement and Locomotion."
5.2 Identify the major bones of the body.	Identify the major structures on a skeleton, chart or text.	Addison-Wesley Biology: Teacher Resource. Unit 7, "The Skeletal Muscular System." Biology of Ourselves: A Study of Human Biology: Chapter 4, "Bones and Joints." Biology: The Science of Life: Chapter 38, "The Skeletal System."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
5.3 Identify the kinds of joints found in the skeleton.	Identify the joints on a skeleton, chart or text.	Biology of Ourselves: A Study of Human Biology: Chapter 4, "Bones and Joints."
6.0 Describe the functions of the skeleton.	Use a skeleton to examine function. Refer to texts for the functions of these structures.	Biology of Ourselves: A Study of Human Biology: Chapter 4. Biology: The Science of Life: Chapter 38, "Skeletal Systems." Anatomy and Physiology: Chapter 5, "The Body Framework."
6.1 List the five functions of the skeleton. 6.2 Describe the functions of the joints identified in 5.3. 6.3 Outline the functions of bone, cartilage, tendons and ligaments.	Discuss the components of the skeletal system and their functions.	
7.0 Describe the role of the skeleton in maintaining homeostasis of minerals and blood cells.	Discuss the role of the skeleton as a reservoir for minerals and a source of blood.	Biology of Ourselves: A Study of Human Biology: Chapter 4. Biology: The Science of Life: Chapter 38, "Skeletal Systems." Anatomy and Physiology: Chapter 5, "The Body Framework."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
8.0 Contrast the structure of visceral, skeletal and cardiac muscle.	Examine prepared slides of muscle.	Biology of Ourselves: A Study of Human Biology: Chapter 5, "Muscles." Bodyworks: Your Human Biology: Chapter 5, "Your Muscles." Biology: The Science of Life: Chapter 38, "Skeletal Systems." Biology of Ourselves: A Study of Human Biology: Chapter 33, "The Muscular System and Muscles."
9.0 Describe the arrangement of muscles that operate antagonistically and synergistically.	Dissect a chicken wing or foot.	Bodyworks: Your Human Biology: "Your Muscles."
9.1 Describe the relationship of muscle groups to providing physical fitness.		Contact Participaction, 80 Richmond Street West, Suite 805, Toronto, for information from "The Shape You're In."
EXTENSIONS		
Disorders of the Skin		
The student should be able to:		
1.0 Describe the cause(s) (where known), symptoms and treatment/prevention of some common skin problems.	Examine such conditions as acne, skin cancer, psoriasis, athlete's foot, blisters and warts.	Biology of Ourselves: A Study of Human Biology: Chapter 3, "The Skin."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
		Biology: The Science of Life: Chapter 39, "The Integumentary System." A Survey of Human Diseases: Chapter 19, "Dermatology and Dermapathology."
Comparative Anatomy of Integumentary Systems The student should be able to:		
1.0 Compare the integumentary structures of several diverse animal types.	Examine and discuss the integuments of such animals as insects, fish, amphibians and reptiles.	Addison-Wesley Biology: Chapter 11, "Movement and Locomotion." Biology: The Science of Life: Essay 39-1, "Other Integuments."
1.1 Describe the relationship of the anatomy of different integuments to the environmental conditions faced by organisms.	Examine and discuss the integuments of such animals as insects, fish, amphibians and reptiles.	Biology: The Science of Life: Essay 39-1, "Other Integuments."
Muscle Fatigue The student should be able to:		
1.0 Explain the stages in muscle fatigue.	Demonstrate muscle fatigue and relate this to cell respiration. Complete lab on muscle fatigue.	Biological Science: A Molecular Approach: Chapter 23, "Skeletal and Muscular Systems." Bodyworks: Your Human Biology: Chapter 5, "Your Muscles."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
		Biology of Ourselves: A Study of Human Biology: Chapter 5, "Muscles."
Identification of Muscles		
The student should be able to:		
1.0 Identify the major groups of skeletal muscles and relate to action of each major group.	Identify major groups of muscles, using a model, chart, or human skeleton.	Anatomy and Physiology: Chapter 6, "The Skeletal Muscles and Body Movements."
Comparison of Skeletal Systems		
The student should be able to:		
1.0 Compare the skeletal systems of a variety of organisms.	Obtain the skeletons, or illustrations of skeletons, of a variety of organisms and have students prepare and assemble animal skeletons.	Biological Science: A Molecular Approach: Chapter 23, "Skeletal and Muscular Systems." Biology: The Science of Life: Chapter 33, "Muscular Systems"; Chapter 38, "Skeletal Systems."
Disorders of Skeletal Systems		
The student should be able to:		
1.0 Discuss factors that contribute to disorders of the skeletal system.	Examine examples of nutritional deficiencies and congenital causes of skeletal abnormalities.	Biology of Ourselves: A Study of Human Biology: Chapter 14, "Nutrition."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
		Biological Science: A Molecular Approach: Appendix 23-A. A Survey of Human Diseases: Chapter 10. Biology: The Science of Life: Chapter 38, "The Skeletal Framework."
1.1 Discuss the difference between fractures, dislocations and sprains.	Examine x-rays and charts of damaged skeletal systems.	A Survey of Human Diseases: Chapter 20. Biology of Ourselves: A Study of Human Biology: Chapter 4.
1.2 Identify the relationship between the symptoms of skeletal diseases such as arthritis and osteomyelitis to bone physiology.	Examine x-rays and charts of damaged skeletal systems.	A Survey of Diseases: Chapter 20.

OPTION K: TITLE: Project or Research TIME: 10-15 hours

RATIONALE: This unit strives to develop in students an understanding of the need for using a critical, quantitative approach when looking at data. An understanding of the and appreciation for both the limitations and uncertainties involved in interpreting biological data can be supported, as this unit directs, by helping students identify a problem for study, to gather and analyze data, and to evaluate information in a critical and objective manner. Since it may be necessary to use a variety of reference materials containing different ideas and approaches, all materials listed in this unit are suggested as single copy references.

SECONDARY REFERENCES:

1. Biological Science Curriculum Study. Biological Science: Interaction of Experiments and Ideas. New Jersey: Prentice-Hall Inc., 1977.

2. Paetkaw, Paul. Projects Sourcebook for Life Science. Canada: Doubleday Canada Ltd., 1975.

3. Kimball, John W. Man and Nature: Principles of Human and Environmental Biology. Menlo Park: CA: Addison-Wesley Publishing Co., Inc., 1975.

4. Province of Manitoba. Safety in Science. Winnipeg: Province of Manitoba, 1982.

5. Morholt, E., et al. A Sourcebook for the Biological Sciences. Toronto: Harcourt, Brace and World, 1966.

6. Alternatives: Perspective on Society and the Environment. Peterborough: Trent University.

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
The student should be able to:		
1.0 State a hypothesis relating energy produced to food available, e.g., food concentration related to carbon dioxide production in yeast. 1.1 Use scientific processes of observation and interpretation of data to test a hypothesis. 1.2 Review the hypothesis relating to the observed data and accept, reject or modify the data for additional testing.	Discuss potential relationships between energy production and availability of food. Emphasis should be upon determining variables which can serve as indicators of this relationship. Once a variable has been identified and examined, the validity of data and potential need for additional variables should be determined. Students should become aware that a number of variables and tests may be needed to eliminate some uncertainty.	Biological Science: Interaction of Experiments and Ideas: "Hypotheses and the Design of Experiments"; "Problems in the Control of Variables." Projects Sourcebook for Life Science: "Projects Using Planarians." NOTE: The objectives and activities suggested are a sample scheme only.
2.0 Specify some principles of of experimental design in relation to the design attempted in 1.0-1.2. 2.1 State variables that affected the problem and give potential alternate hypotheses and investigations that could be tested.	Determine, by discussion, some additional potential tests, and investigate a hypothesis which is related to the previous hypothesis but which still examines the general relationship between energy and food availability.	Biological Science: Interaction of Experiments and Ideas.

OPTION L: TITLE: Land Use (TO BE REDESIGNED)

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biology 300 (core)

BIOLOGY DESIGN CHARTS FOR BIOLOGY 300 CORE

UNIT I: TITLE: Gene Action: DNA/RNA/Protein Synthesis TIME: 8-10 hours (core)

RATIONALE: The variations among living things are largely due to enzymatic differences as specified by the genetic code. An understanding of the code, its replicating and its expression in protein synthesis are central to the study of modern biology. An understanding of the structure of the DNA molecule and its replication in cell division is also essential for an understanding and appreciation of genetics and the mechanism of evolution. The recent development of recombinant DNA and its use may have profound implications for both the individual and society. The student should be aware of these technological advances in order to make rational decisions on matters pertaining to these topics. This unit covers a thorough study of DNA, protein synthesis and mutation.

TEACHER REFERENCES:

1. "Mutation Mumbo Jumbo," The Science Teacher, vol. 49, no. 3 (March 1978).
2. Cairns, John. Cancer: Science and Society. W.H. Freeman and Co., 1978.
3. Watson, James. The Double Helix. Atheneum, 1978.
4. Purtilo, David T. A Survey of Human Diseases. Don Mills, ON: Addison-Wesley Publishing Co., 1980.

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
The student should be able to:		
1.0 Describe the physical structure of DNA and how it relates to the physical nature of a chromosome.	1.0-1.4 Do a lab to illustrate the arrangement and composition of a DNA molecule.	1.0-1.4 Addison-Wesley Biology: Chapter 15, "Reproduction of Molecules and Cells."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
	* Use DNA model kits to illustrate DNA structure and DNA replication.	Biology: The Science of Life: Chapter 42, "Nucleic Acids and the Genetic Code."
1.1 Identify the six molecular components of DNA by name and by simplified molecular (block) diagrams.		DNA Model Kit by K D Biographics.
1.2 Describe, with the aid of diagrams, the molecular structure of DNA.		Biology and Human Concerns: Chapter 21, "Human Hemoglobins and and Gene Action."
1.3 Describe, using simplified diagrams, the replication of the DNA molecule.		Biological Science: A Molecular Approach: Chapter 8, "Master Molecules."
1.4 Identify the functions of the DNA molecule.	Discuss the role of information storage and information transfer of the DNA molecule.	Biology Investigations: Lab 7, "DNA and Its Structures."
	*	Addison-Wesley Biology: Laboratory Manual: Experiment 40, "DNA and RNA."
2.0 Identify the molecular components and draw simplified diagrams of mRNA and tRNA.	A laboratory activity using molecular models is recommended.	Biological Science: A Molecular Approach: Chapter 9, "The Genetic Code."
2.1 Compare the structure of DNA, mRNA and tRNA.		Biology: The Science of Life: Chapter 42, "Nucleic Acids and the Genetic Code."
		Laboratory Biology: Investigating Living Systems: Lab 24, "DNA and RNA."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
		Biology of Ourselves: A Study of Human Biology: Chapter 20, "Human Genetics." Laboratory Biology: Investigating Living Systems: Lab 25, "tRNA and Protein Building."
2.2 Describe the process of protein synthesis using simplified diagrams.	Have students examine an example of a nucleotide sequence and have them decipher the mechanism by which the code can be used to represent specific amino acids. Stress that the codon must contain at least twenty different notations. Do a lab to illustrate protein synthesis.	
2.3 Explain why changes in DNA codons may alter the composition of a protein.	Examine a chart that illustrates the relationship between specific codons and amino acids. Have students identify the common elements of codons that relate to the same amino acid. Discuss changes in the code that will not change the meaning of the codon.	

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
2.4 Discuss the implications of codon change to the composition of the protein produced.		Biology and Human Concerns: Chapter 21, "Human Hemoglobins and Gene Action"; Chapter 23, "Inborn Errors of Metabolism."
2.5 Identify some common conditions which result from faulty protein synthesis, e.g., sickle-cell anemia, phenylketonuria.		
3.0 Define mutation and give some examples of factors that cause mutation, e.g., relate the specific effects of ultraviolet light, ethylmethane sulfonage (EMS), Benzpyrene (BP) and replication error on the genetic code.		Cancer: Science and Society Addison-Wesley Biology: Chapter 20, "Heredity: Chromosomes and Genes."
3.1 Describe examples of spontaneous and induced mutations as they pertain to the genetic code within DNA, e.g., compare the effect of background cosmic radiation to the use of medical radiation and chemical pollutants in the production of mutations.		Biology: The Science of Life: Chapter 44, "Genetic Change and Evolution." Biology and Human Concerns: Chapter 30, "Genetic Variation and Mutation." Biological Science: A Molecular Approach: Chapter 15, "Changes in Genes."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
EXTENSIONS		
History of DNA Research		
The student should be able to:		
1.0 Describe the significant events that led to the present knowledge of DNA structure and function.	Research the work and experiments of Miescher, Griffith, Hershey, Chase, Nirenberge, Matthaei, Har Gobind Khorana, Watson and Crick on DNA structure and function.	The Double Helix Biological Science: An Inquiry into Life: Chapter 7, "The Hereditary Materials"; Chapter 7, Inquiry 7-1, "The Structure of DNA." Biological Science: A Molecular Approach: Investigation for Chapter 8, "Bacteria, Pneumonia and DNA."
Genetic Change and Its Consequences		
The student should be able to:		
1.0 Describe the effect of chromosomal mutation on the expression of the genetic code, e.g., discuss, using models, such chromosomal mutations as translocation, inversion, deletion, and changes in chromosome number.	Do a lab on identifying or producing mutant organisms.	Laboratory Biology: Investigating Living Systems: Lab 26, "Biochemical Evidence for Evolution." Biology and Human Concerns: Chapter 25, "Human Chromosomes and Autosomal Abnormalities."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
		Biological Science: A Molecular Approach: Investigation for 9.9A, "How Can Mutant Strains of Bacteria Be Isolated"; 9B, "Effects of Radiation on Microorganisms"; 9C, "What Controls the Synthesis of Large Molecules in a Living Cell." Biological Science: An Introductory Study: Chapter 27, Investigation 27.8, "Mutation Studies in Plants." A Survey of Human Diseases: Chapter 9, "Inherited Disorders."

UNIT II: TITLE: Introduction to Human Genetics TIME: 10-15 hours (core)

RATIONALE: A unit on genetics is desirable in order to instil in students an understanding of the causes and effects of mutations on biological variation. Since one's genetic makeup is central to the health and well-being of the individual and to families and even populations, a knowledge of genetics and its implications is important in providing the student with a background that may help him or her choose suitable courses of action when planning children. It is essential that students be aware of present technology that might prevent undue tragedy and suffering for themselves and future offspring. This unit covers the fundamentals of human genetics.

TEACHER REFERENCES:

1. Tribe, Michael A., et al. Case Studies in Genetics. London: Cambridge University Press, 1978. (Canadian representative: Pendragon, Mississauga, ON.)

2. Capra, Judy L. Genetics: A Human Approach. Denver, CO: Genetics Unit, University of Colorado Health Sciences Centre, 4200 East Ninth Avenue, 1981.

3. Volpe, Peter E. Biology and Human Concerns. Third edition. Dubuque, IA: Wm. C. Brown Co., 1983.

4. BSCS. Basic Genetics: A Human Approach. Dubuque, IA: Kendall-Hunt Publishing Company, 1983. (A student's guide and a teacher's guide are available.)

5. --------. Genetic Series: Tay-Sachs; Down's Syndrome. White Plains, NY: March of Dimes, 1982. (These sheets are available from the Curriculum Development and Implementation Branch, Manitoba Education.)

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
The student should be able to:		
1.0 Identify variations in humans which are inherited.	Do a lab on salivary amylase to illustrate the relationship between heredity and adaptation (Lab 42).	Addison-Wesley Biology: Chapter 19, "Genetics: Mendel's Laws of Heredity"; Chapter 20, "Heredity: Chromosomes and Genes."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
		Biology of Ourselves: A Study of Human Biology: Chapter 20, "Human Genetics." Biology: The Science of Life: Chapter 41, "Human Genetics." Laboratory Biology: Investigating Living Systems: Lab 27, "A Human Variation with Possible Adaptive Value."
1.1 Investigate the probability of gene transmission.	* Review probability with dice, coins, playing cards, and computer simulations.	Biology and Human Concerns: Chapter 20, "Mendelian Inheritance in Humans." Biology of Ourselves: A Study of Human Biology: Chapter 20, "The Transmission of Genes." Biological Science: A Molecular Approach: Chapter 13.
1.2 Describe the work of Mendel in terms of our present genetic knowledge.	Do library research on the significance of Mendel's work in the development of the study of genetics.	Biology: The Science of Life: Chapter 41, "Genetics."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
		Biological Science: A Molecular Approach: Chapter 13.
1.3 Define the terms chromosome, gene, allele, phenotype, genotype, heterozygous, dominant, recessive, homozygous.	Do laboratory investigations on phenotypes and genotypes for traits.	Biology of Ourselves: A Study of Human Biology: Chapter 20, "Inheritance." Laboratory Biology: Investigating Living Systems: Lab 18, "Finding Phenotypes and Genotypes for One Trait"; Lab 19, "Finding Phenotypes and Genotypes for Two Traits." Biological Science: An Introductory Study: Investigation 27-2, "Heredity in Fruit Flies."
2.0 Interpret the dominant and recessive characteristics of genes in terms of gene chemical action, e.g., emphasize that gene control is chemical (DNA) control of trait expression.		Biology and Human Concerns: Chapter 17, "Chemical Basis of Inheritance."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
		Biology: The Science of Life: Chapter 43, "Genes and Development in Eucaryotic Organisms."
2.1 Predict the results of monohybrid and dihybrid crosses.	Complete the PTC lab test and phenotype survey lab. Do genetic problems representing monohybrid and dihybrid crosses.	Biological Science: An Introductory Study: Investigation 26.2, "The Transmission of Traits in Corn and Soybeans." Biology of Ourselves: A Study of Human Biology: Chapter 20, "Human Genetics"; Chapter 20, Activity 1, "The Ability to Taste PTC." Biology: The Science of Life: Chapter 41, "Genetics."
2.2 Prepare a monohybrid pedigree from an analysis of phenotypic characteristics of several generations.	Complete a pedigree review lab.	Biological Science: A Molecular Approach: Lab 16-B, "Variation in Human Species." Bodyworks: Your Human Biology: Lab X, "Your Human Genetics." Biological Science: An Introductory Study: Investigation 27.4, "The Pattern of Hemophilia in Queen Victoria's Pedigree."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
		Biology of Ourselves: A Study of Human Biology: Chapter 29, "Pedigrees." Laboratory Biology: Investigating Living Systems: Lab 20, "Pedigree Studies." Biology and Human Concerns: Chapter 20, "Mendelian Inheritance in Humans."
2.3 Describe inherited characteristics determined by multiple genes.	Do classroom exercises on hair and skin colour.	Biology of Ourselves: A Study of Human Biology: Chapter 20, "Multiple Genes." Biology: The Science of Life: Chapter 41, "Genetics." Biology and Human Concerns: Chapter 22, "Human Blood Groups and Hemolytic Disease."
2.4 Describe inherited characteristics determined by multiple alleles of a single gene.	Do classroom exercises on blood groups.	Biology of Ourselves: A Study of Human Biology: Chapter 20, "Environmental Factors."
2.5 Describe the effects of environment on the expression of some genes.	* Do a laboratory investigation on heredity and the environment.	Biology: The Science of Life: Chapter 44, "Genetic Change and Evolution." Laboratory Biology: Investigating Living Systems: Lab 22, "Heredity or Environment?"

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
3.0 Explain the role of chromosomes in sex determination.	* Do a karyotype lab and a dry lab on sex linkage. * Do problems involving sex-linked inheritance.	Addison-Wesley Biology: Laboratory Manual: Experiment 42, "Studying Human Chromosomes." Biological Science: A Molecular Approach: Chapter 14. Biology of Ourselves: A Study of Human Biology: Chapter 20, "Sex Determination." Laboratory Biology: Investigating Living Systems: Lab 21, "A Chromosome Study"; Lab 23, "Sex-Linked or Not Sex-Linked."
3.1 Relate the mechanism of sex-linked inheritance to the distribution of sex-linked traits.	Do a lab using colour-blindness charts.	Biology of Ourselves: A Study of Human Biology: Chapter 20, "Sex Linkage."
3.2 Relate abnormal sex chromosome numbers to expression and development of sex traits.	* Describe Klinefelter's syndrome, Turner's syndrome, XXX syndrome.	Biology and Human Concerns: Chapter 21, "Human Hemoglobins and Gene Action." Biology of Ourselves: A Study of Human Biology: Chapter 20, "Sex Linkage."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
		Biology: The Science of Life: Chapter 41, "Sex Determination and Sex Linkage." A Survey of Human Diseases: Chapter 9, "Inherited Diseases." Biology of Ourselves: A Study of Human Biology: Chapter 20, "Genetic Factors."
3.3 Identify some causes and consequences of the following genetic abnormalities: - monosomy - trisomy - translocation - inversion		Biology: The Science of Life: Chapter 44, "Genetic Change and Evolution." Biological Science: An Introductory Study: Chapter 9, "Inherited Disorders."
3.4 Give examples of dominant and recessive metabolic disorders and differentiate between the probabilities of the expression of such traits in the offspring of carriers.	Describe such diseases as Huntington's disease, "elephantman disease," achonodroplasia, cystic fibrosis, Tay Sach's disease, albinism.	Biology of Ourselves: A Study of Human Biology: Chapter 20, "Birth Defects."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
		Biology: The Science of Life: Chapter 41, "Genetics." Genetic Series: Tay-Sachs; Down's Syndrome Biology and Human Concerns: Chapter 19, "Mendelian Inheritance in Man"; Chapter 23, "Inborn Errors of Metabolism."
4.0 Describe the process of crossing over between linked genes and its consequences for genetic variation. 4.1 Describe how chromosomes are mapped using crossing over between linked genes.	Manipulate a model that illustrates crossing over.	
4.2 Relate recombination to genetic variability.		Biology of Ourselves: A Study of Human Biology: Chapter 20, "The Transmission of Genes."

UNIT III: TITLE: Bioenergetics TIME: 12-20 hours (core)

RATIONALE: Energy production and utilization are basic to all living organisms. This unit examines the process by which light energy is collected and converted, through photosynthesis, into a usable product. In the process of cell respiration, the organic products derived are aerobically broken down, resulting in the release of energy. The end product of this symbiotic relationship is the substance called adenosine triphosphate, which is necessary to carry out living cell activities.

SCONDARY REFERENCES:

1. BSCS Yellow Version. Biological Science: An Inquiry Into Life. New York: Harcourt Brace Jovanovich, 1980.

2. Evans, William F. Anatomy and Physiology. Third edition. New Jersey: Prentice-Hall Inc., 1983.

TEACHER REFERENCES:

1. Gay, John, et al. Current Health Problems. Toronto: W.B. Saunders Co., 1979.

2. Purtilo, David T. A Survey of Human Diseases. Don Mills, ON: Addison-Wesley Publishing Co., 1980.

3. Andrews, W.A., et al. Biological Science: An Introductory Study. Scarborough, ON: Prentice-Hall of Canada, Ltd.

4. Volpe, Peter E. Biology and Human Concerns. Third edition. Dubuque, IA: Wm. C. Brown Co., 1983.

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
Photosynthesis		
The student should be able to:		
1.0 Relate the visible energy spectrum to the total electromagnetic spectrum.	Use a prism to observe the components of sunlight.	Addison-Wesley Biology: Chapter 5, "Food Production and Nutrition."
1.1 State the relationship between the colour of a surface and the portion of the energy spectrum that is absorbed, reflected or transmitted.		Biological Science: An Introductory Study: Chapter 7, Investigtion 7.3B, "Some Properties of Chlorophyll."
1.2 Interpret a graph showing the relationship between light absorption by chlorophyll and light wave length.		Biological Science: A Molecular Approach: Chapter 6.
2.0 Describe the structure of the chloroplast.	Examine electron micrographs to illustrate the organization of chloroplasts.	Addison-Wesley Biology: Laboratory Manual: Experiment 16, "Separating Plant Pigments by Chromatography."
2.1 Identify the types of chlorophyll and other photosynthetic pigments.	Do a lab on the separation and identification of plant pigments.	Laboratory Biology: Investigating Living Systems: Lab 51, "Chloroplast Pigment Analysis."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
3.0 Write a summation equation for photosynthesis: $6H_2O+6CO_2O \xrightarrow[\text{light}]{\text{energy}} C_6H_{12}O_6+6O_2$		Addison-Wesley Biology: Laboratory Manual: Experiment 17, "Gas Production in Photosynthesis."
3.1 Relate factors such as carbon dioxide concentration, temperature and light intensity to the rate of photosynthesis.	Do a lab to demonstrate the influence of various factors on photosynthesis.	Laboratory Biology: Investigating Living Systems: Lab 50, "Influencing Rate of Photosynthesis." Biological Science: A Molecular Approach: Investigations 6A-C. Biological Science: An Introductory Study, Investigation 7.2, "Photosynthesis." Laboratory Investigations in Biology, Lab 6, "Photosynthesis and Cellular Respiration."
3.2 Identify the products of photosynthesis, including "photo-phosphorylation using simplified diagrams.	Do a lab or demonstration showing the presence of carbohydrates in plant tissue.	Biological Science: An Introductory Study: Investigation 7.2C, "Testing for Starch in Green Plants."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
3.3 Interpret the chemical events of the light and dark reactions using simplified diagrams.		Biology: The Science of Life: Chapter 11, "Photosynthesis." Biology and Human Concerns: Chapter 45, "Biotic Communities: Plants as Producers."
4.0 Relate the process of photosynthesis to the variations in structure and function of plant organs.	Do a laboratory investigation on leaf anatomy.	Biological Science: A Molecular Approach: Chapter 6. Laboratory Biology: Investigating Living Systems: Lab 52, "Leaf Anatomy." Biology: The Science of Life: Chapter 13, "Cycles of Matter." Biological Science: A Molecular Approach: Chapter 6, "Light as the Energy of Life."
5.0 Relate the environmental and economic importance of photosynthesis to food, fuel and oxygen production.		Biology: The Science of Life: Chapter 11, "Photosynthesis."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
Cell Respiration The student should be able to:		
1.0 Write and interpret the summation equation for aerobic respiration. The representative equation is: $C_6H_{12}O_6+6O_2 \longrightarrow 6CO_2+6H_2O$ + energy		Addison-Wesley Biology: Chapter 6, "Obtaining Energy from Food." Biological Science: A Molecular Approach: Chapter 7, "Life with Oxygen." Biology of Ourselves: A Study of Human Biology: Chapter 1, "Knowledge of the Human Body." Biology: The Science of Life: Chapter 1, "Respiration."
1.1 Write and interpret the equation for the production of ATP in aerobic respiration. $ADP + P \rightleftarrows ATP$	Do a laboratory investigation of yeast respiration.	Laboratory Biology: Investigating Living Systems: Lab 10, "Cell Energy"; Lab 11, "Factors Influencing Rate of Yeast Respiration." Biology: The Science of Life: Chapter 12, "Photosynthesis." Biological Science: An Introductory Study: Chapter 7, "Cell Physiology: Photosynthesis and Respiration."
1.2 Give examples of the use of energy from ATP in the human body.	Discuss energy requirements for temperature, locomotion, protein synthesis.	Biology: The Science of Life: Chapter 9, "A Little Physics: Energy."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
		Biology and Human Concerns: Chapter 6, "Cellular Metabolism."
2.0 Write and interpret the summation equation for anaerobic respiration. The representative equation is: $C_6H_{12}O_6 \longrightarrow 2C_2H_5OH + 2CO_2$	Use a lab comparison of aerobic and anaerobic respiration (yeast experiment).	Biology: The Science of Life: Chapter 12, "Fermentations." Bodyworks: Your Human Biology: ter 5, "Your Muscles." Biological Science: An Introductory Study: Chapter 9, "Monerans and Viruses."
2.1 Relate the occurrence of aerobic respiration to the complexity of an organism and compare the advantages of aerobic and anaerobic respiration.	Organize a laboratory activity on using carbon dioxide production to compare differences in muscular activity.	Biology: The Science of Life: Chapter 12, "Fermentations." Biological Science: A Molecular Approach: Lab 7-A, "Life with Oxygen." Laboratory Biology: Investigating Living Systems: Lab 68, "Measuring Differences in Muscular Activity." Biological Science: An Introductory Study: Lab 7.6, "Cellular Respiration."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
3.0 Interpret the Krebs Cycle, using simplified diagrams to illustrate the intermediary stages of respiration that are needed to convert carbohydrates, proteins and fats into energy.		Anatomy and Physiology: Chapter 12, "Aerobic Respiration." Biology and Human Concerns: Chapter 6, "Cellular Metabolism." Biological Science: A Molecular Approach: Chapter 7, and Appendix 7-A. Biology: The Science of Life: Chapter 3, "Aerobic Respiration."
4.0 Describe the relationship between photosynthesis, respiration, and the carbon, hydrogen and oxygen cycle.		Biology: The Science of Life: Chapter 13, "Cycles of Matter." Biological Science: A Molecular Approach: Chapter 5, "Light as the Energy of Life."

UNIT IV-A: TITLE: Variety in Animals TIME: 13-15 hours (core)

RATIONALE: The profusion of animal species which has inhabited and presently does inhabit the earth is due to the presence of fauna adapting to and evolving in a variety of habitats. This unit introduces the study of animal life in its variety by presenting a categorical review of animal types and by examining the types of environmental stresses that exist and the ways in which animals have come to deal with these stresses. This approach is designed to instil in the student an awareness of the evolutionary trends that are found in animals and to provide a basic knowledge about ways of interpreting human physical characteristics.

SECONDARY REFERENCE:

1. BSCS Yellow Version. Biological Science: An Inquiry into Life. Fourth edition. New York: Harcourt Brace Jovanovich, 1980.

TEACHER REFERENCE:

1. Attenborough, David. Life on Earth. Boston: Little, Brown and Co., 1981.

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
The student should be able to:		
1.0 Describe the criteria by which animals are organized into groups.		Addison-Wesley Biology: Chapter 2, "Classification of Living Things."
2.0 Identify the main distinguishing characteristics of the major phyla.	Dissect representative examples from several of the phyla. Compare specimens or illustrations of representative samples of several phyla.	Biological Science: A Molecular Approach: Chapter 2, "Living Things." Biological Science: An Inquiry into Life: Part III, "Diversity."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
	Conduct investigtions on keying, do a survey of phyla of simple animals and dissections from representative phyla.	Laboratory Biology: Investigating Living Systems: Lab 32, "Using and Making a Biological Key"; Lab 37, "A Survey of Some Animal Phyla"; Lab 38, "Earthworm Anatomy"; Lab 39, "Arthropods"; Lab 40, "Starfish."
2.1 Use an identification key effectively. 2.2 Explain the limitations of classification systems.	Match specimens of animals to thier correct phyla and give reasons for the match.	1.2-1.3 Laboratory Biology: Investigating Living Systems: Lab 31, "Classification." Biological Science: An Inquiry into Life: Inquiry 12-1.
2.3 Relate phylogenetic position to evolutionary progress.		Laboratory Biology: Investigating Living Systems: Lab 30, "Evolutionary Changes in Primates."
3.0 Identify the main distinguishing characteristics of the following chordate classes: - Agnatha - Chondrichthyes - Osteichthyes - Amphibia		

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
- Reptilia - Aves - Mammalia		
NOTE TO TEACHERS: Stress the evolutionary themes evident from examination of these classes.	Do comparative dissection of representative examples of the chordate classes.	
4.0 Trace the evolutionary changes that have occurred in the structure of a vertebrate system.	3.0-3.4 Trace the evolutionary changes in some of the following systems: digestive, reproductive, nervous, skeletal, excretory.	3.0-3.4 Biology: The Science of Life: Essay 34-2, "Other Circulatory Systems"; Essay 35-1, "Other Excretory Systems"; Essay 36-2, "Other Nervous Systems"; Essay 37-1, "Other Endocrine Systems"; Essay 38-1, "Exoskeletons"; Essay 39-1, "Other Integuments"; Essay 31-1, "Other Digestive Systems"; Essay 32-1, "Other Respiratory Systems"; Essay 33-1, "Other Muscular Systems."
4.1 Discuss the adaptive significance of these changes.	Dissect fish, amphibian and mammalian hearts or another organ system in these classes.	Laboratory Biology: Investigating Living Systems: Lab 27, "A Human Variation with Possible Adaptive Value"; Lab 62, "Digestive System of Frog and Human."
4.2 Examine an organism and infer the type of environment to which it is adapted.		Biological Science: A Molecular Approach: Chapters 17-20.

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
EXTENSIONS Adaptation The student should be able to: 1.0 Identify the particular stresses that each of the following environments place on an animal: - marine - freshwater - arctic - temperate - tropical - arid - humid 1.1 Give examples of how animals have adapted to each of the stresses identified in 1.0. 1.2 Infer the environment(s) to which an animal is adapted by examination of one or more of its structural characteristics. 1.3 Predict the changes that might occur in an animal population over a long period of time in response to a specific environmental change.	1.0-1.3 Conduct field studies of the structural, functional and behavioral responses of local fauna to the environment. Stress winter adaptations. Do lab activity on natural selection.	1.0-1.3 Biological Science: An Inquiry into Life: Chapter 2, "Living Things"; Chapter 9, "Change Through Time--Evolution"; Inquiry 9-1, "Natural Selection." Biological Science: A Molecular Approach: Chapter 24.

Unit IV-B: TITLE: Variety in Plants TIME: 8-10 hours (core)

RATIONALE: There are more than 250,000 plant species ranging from the simple blue-green algae to the complex spermatophytes. This unit emphasizes how all plant species share some common structures and processes and that each also shows particular evolutionary adaptations for life and reproduction in various aquatic and terrestial environments. As we learn more about the structure and function of plants and how they react to their environment, we are able to modify them and control their growth. Because of this, a very small number of plant species can support the present vast human population. This unit covers discussions on four types of green algae, mosses, lichen and fungi as well as a discussion of the significance of technological advances on modern agriculture.

SECONDARY REFERENCE:

1. BSCS Yellow Version. Biological Science: An Inquiry into Life. Fourth edition. New York: Harcourt Brace Jovanovich, 1980.

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
The student should be able to:		
1.0 Describe the general features of four types of green algae: unicellular, filamentous, colonial and multicellular.	Examine microslides or fresh samples of algae.	Addison-Wesley Biology: Chapter 2, "Classification of Living Things." Addison-Wesley Biology: Laboratory Manual: Experiment 8, "Algae." Biology: The Science of Life: Chapter 2, "Naming and Classification of Living Things." Biological Science: A Molecular Approach: Chapter 2, "Living Things."
1.1 Trace the development of division of labour using algae as an example.		
1.2 Describe, compare and contrast isogamy, heterogamy and conjugation.	Examine prepared slides of fresh samples of spirogyra.	

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
1.3 Describe vegetative reproduction in algae. 1.4 Apply the concept of vegetative reproduction to higher plants, e.g., in horticulture.	* Do laboratory activities on algae and lichens.	Biology: The Science of Life: Chapter 20, "Mitosis and Meiosis." Laboratory Biology: Investigating Living Systems: Lab 34, "Lichens"; Lab 35, "Algae Plants." Biological Science: A Molecular Approach: Chapter 11, "Reproduction."
2.0 List problems of adaptation for plants in a terrestrial environment which are not found in an aquatic environment.	* Examine the adaptations of plants to water retention/absorption, gas exchange and reproduction.	Addison-Wesley Biology: Laboratory Manual: Experiment 43, "Mosses and Liverworts"; Experiment 44, "Ferns."
2.1 Describe the list cycle of a moss.	* Conduct laboratory activities on liverworts and ferns, and the moss life cycle.	Laboratory Biology: Investigating Living Systems: Lab 49, "Moss Plants and Alteration of Generations"; Lab 36, "Liverworts, Mosses and Ferns."
2.2 Describe the structure of a moss. 2.3 State how (2.1) and (2.2) are adaptations to a terrestrial environment.	* Collect a variety of mosses and examine their structures, e.g., the rhizoid spore.	Laboratory Investigations in Biology: Lab 21, "Mosses and Ferns." Biological Science: An Inquiry into Life: Inquiry 21-3, "Mosses: Primitive Land Plants."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
2.4 State difficulties in a terrestrial environment which the mosses have not overcome completely.		
3.0 Define the term angiosperm.		Biology: The Science of Life: Chapter 27, "Flowers"; Chapter 28, "Fruits, Seeds and Seedlings." Addison-Wesley Biology: Chapter 2, "Classification of Living Things."
3.1 Define the term gymnosperm.		
3.2 Describe how flowering plants have adapted to a terrestrial existence.		Biological Science: An Inquiry into Life: Chapter 21, "Plant Growth and Reproduction."
4.0 Define and give one example of a mesophyte, a hydrophyte and a xerophyte.	Examine leaf cross-sections of a hydrophyte, mesophyte and xerophyte under a microscope.	Biology: The Science of Life: Chapter 22, "The Leaf." Addison-Wesley Biology: Laboratory Manual: Experiment 15, "Leaves."
4.1 Contrast hydrophyte and xerophyte structures and relate them to the environment.		

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
4.2 Discuss the evolutionary reasons for the decline of the gametophyte.		Biology: The Science of Life: Chapter 20, "Mitosis and Meiosis."
4.3 Explain how plants respond to short-term environmental changes.	Do a laboratory activity on the effects of chemicals upon plants.	Addison-Wesley Biology: Laboratory Manual: Experiment 61, "Movement in Plants."
4.4 Explain dormancy, photoperiodism, leaf loss, germination, tropism, auxin, cytokinin.		Biology: The Science of Life: Chapter 29, "Plant Hormones." Laboratory Biology: Investigating Living Systems: Lab 55, "Influence of Hormones on Plant Growth." Biological Science: An Inquiry into Life: Inquiry 21-1, "Plant Responses to Environment." Addison-Wesley Biology: Laboratory Manual: Experiment 10, "Fungi."
EXTENSIONS		
Fungi		
The student should be able to:		
1.0 Diagram the structures of a typical fungi, e.g., penicillium.	Do a lab on growing molds under a variety of conditions. Identify a penicillin mold and have students examine the microscopic structure of this mold. Dissect a mushroom.	Laboratory Biology: Investigating Living Systems: Lab 42, "Reproduction in Fungi."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
1.1 Describe the heterotrophic nutrition of a fungi and the difference between a parasite and a saprophyte.	Refer to above activity.	Biology: The Science of Life: Chapter 4, "Interaction Among Species."
1.2 Describe some common parasitic fungi and their significance to agriculture, e.g., corn smut, wheat rust.	Examine the life cycle and the potential consequences upon agriculture of an important fungus.	Information Services, Department of Agriculture, Ottawa, K1A 0C7: Cucumber Diseases (Publication 1684); Diseases and Pests of Potatoes (Publication 1492); Tomato Diseases (Publication 1492); Ergot of Grains and Grasses (Publication 1438). Biology: The Science of Life: Chapter 17, "Biological Control of Pest Populations"; Chapter 14, "Food Chains and Food Webs."
1.3 Describe the economic, biological and medical importance of fungi in the area of plant disease/decomposition and antibiotics/food products.	Do a lab to demonstrate the effect of various environmental conditions on the rate of decomposition. Make sauerkraut, wine or cheese.	Biology: The Science of Life: Chapter 2, "Naming and Classification of Living Things."
Lichen		
The student should be able to:		
1.0 Describe the structure of a lichen.	Have students collect a variety of lichens and sort them into the three groups: fruticose, foloise and crustose.	1.0-1.1 "The Nature of Lichens," Natural History, vol. 91, no. 3 (March 1982).

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
	Discuss the organization and structure of a lichen.	
1.1 Discuss the symbiotic relationship found in a lichen, showing the advantages of symbiosis.	Have students collect lichens and record the environmental conditions where each is found. Discuss the implications of the results.	Biology: The Science of Life: Chapter 6, "Interactions Among Species."
Chemical Technology		
The student should be able to:		
1.1 Give some examples of how science and technology improve yields in modern agriculture.		
1.2 Discuss the benefits and dangers inherent in the use of chemicals in agriculture.		
1.3 Discuss the need to preserve wild plant species as a gene pool.	Examine habitat destruction and its potential effect on crop development and vigour.	

UNIT V: TITLE: Angiosperms TIME: 8-10 hours (core)

RATIONALE: In Biology 200, the human species was used to demonstrate the structure and functions of the organ systems in all animals. In this unit, Angiosperms, it is suggested that a common plant (e.g., a tomato, bean or pea) be studied to demonstrate the structure and function of the various systems in all angiosperms. The unit covers the structure and functions of the plant cell, root, stem, leaf, and the reproductive parts of the plant. There is also a discussion of plant reproduction, photosynthesis and the relationship of plant life to our environment.

SECONDARY REFERENCES:

1. Andrews, W.A., et al. Biological Science: An Introductory Study. Scarborough, ON: Prentice-Hall of Canada Ltd., 1980.

2. Zuerner, F. and A. Camosy. Plants in the Laboratory. Washington: National Association of Biology Teachers, 1984.

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
The student should be able to:		
1.0 List the parts of a generalized plant cell: cell wall, membrane, chloroplasts, vacuole and cytoplasm.	Review plant cell structure.	Addison-Wesley Biology: Chapter 3, "The Cell: Basic Unit of Life." Biology: The Science of Life: Chapter 18, "The Cell."
1.1 Describe the structure and functions of each of the above.	Do a cell study of a potato and/ or a tomato.	2.0-2.3 Addison-Wesley Biology: Chapter 7, "Gas Exchange"; Chapter 9, "Transport"; Chapter 17, "Reproduction, Growth, and Development of Plants."
2.0 Define three functions of a root.	2.0-2.3 Examine prepared slides of root tissue.	Biology: The Science of Life: Chapter 23, "The Root: Primary Growth."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
2.1 Identify the tissue types found in a root cross-section. 2.2 State the characteristics of each tissue type. 2.3 Define the functions of each tissue type.		Addison-Wesley Biology: Laboratory Manual: Experiment 20, "Roots." Laboratory Biology: Investigating Living Systems: Lab 54, "Stems and Roots." Biological Science: An Inquiry into Life: Chapter 20, Inquiry 20-5, "The Structure and Function of Roots." Biological Science: An Introductory Study: Investigation 15-3, "Root Structure"; Investigation 15-4, "Root Functions." Biological Science: A Molecular Approach: Chapter 17, "Transport Systems."
2.4 Describe the mechanics of the uptake of water and minerals by the root hair.		Biology: The Science of Life: Chapter 21, "Transpiration and the Movements of Water in Plants."
3.0 Define the functions of a stem.	3.0-3.4 Examine slides of plant stems. Do a laboratory investigation on root growth.	Laboratory Biology: Investigating Living Systems: Lab 55, "Influence of Hormones on Plant Growth." Addison-Wesley Biology: Laboratory Manual: Experiment 21, "Stems."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
3.1 Identify the tissue types found in a stem. 3.2 State the characteristics of each tissue and relate them to similar tissues in the root. 3.3 Define the function of each tissue and relate it to root functions.		Biology: The Science of Life: Chapter 24, "The Stem: Primary Growth." Biological Science: An Inquiry into Life: Chapter 20, Inquiry 20-4, "Herbaceous Stems." Biological Science: An Introductory Study: Investigation 5-7, "Stem Structure"; Investigation 5-8, "Twigs." Biological Science: A Molecular Approach: Chapter 17, "Transport Systems"; Lab 17-A.
3.4 Describe the mechanics of the transportation of materials up and down a stem.	Conduct a laboratory investigation of transport in plants.	Biology: The Science of Life: Chapter 26, "Transportation and the Movement of Water in Plants." Addison-Wesley Biology: Laboratory Manual: Experiment 30, "Water Movement in Plants." Laboratory Investigations in Biology: Lab 24, "Roots and Stems"; Lab 25, "Water Relations."
4.0 Relate the role of chlorophyll, water, carbon dioxide and light to the photosynthetic reaction.		Biology: The Science of Life: Chapter 22, "The Leaf." Laboratory Biology: Investigating Living Systems: Lab 52, "Leaf Anatomy."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
4.1 Describe the function of the leaf.	Do a laboratory investigation of the leaf.	Addison-Wesley Biology: Laboratory Manual: Experiment 15, "Leaves." Biological Science: A Molecular Approach: Chapter 20, Inquiry 20-3, "Leaf Structure and Function." Biological Science: An Introductory Study: Investigation 15-10, "Leaf Structure"; Investigation 15-11, "Leaf Epidermis." Biological Science: A Molecular Approach: Chapter 17, "Transport Systems."
4.2 Identify the tissue types found in a dicot leaf.		Biology: The Science of Life: Chapter 21, "The Flowering Plant"; Chapter 22, "The Leaf."
4.3 Describe the structure and function of each tissue type.		Biology: The Science of Life: Chapter 23, "The Root: Primary Growth." Laboratory Investigations in Biology: Lab 23, "Leaves."
4.4 Describe the structure and function of stomata.		Biology: The Science of Life: Chapter 22, "The Leaf."
5.0 Identify the calyx, corolla, stamen and pistils.	Dissect a flower.	Addison-Wesley Biology: Laboratory Manual: Experiment 45, "Flower and Seed."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
		Biological Science: A Molecular Approach: Chapter 11, "Reproduction." Biology: The Science of Life: Chapter 27, "Flowers." Laboratory Biology: Investigating Living Systems: Lab 47, "Flower Anatomy." Biological Science: An Introductory Study: Investigation 14-6, "Structure of a Simple Flower"; Investigation 14-7, "Structure of a Composite Flower." Biology: The Science of Life: Chapter 27, "Flowers."
5.1 Describe the structure and function of the elements in 5.0. 5.2 Describe the formation of a megaspore and microspore. 5.3 Describe the process of fertilization. 5.4 Relate the process of pollination and fertilization to its evolutionary significance.		

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
6.0 Describe the structure and function of a seed.	* Do a laboratory investigation of seeds.	Biology: The Science of Life: Chapter 28, "Fruits, Seeds, and Seedlings." Laboratory Biology: Investigating Living Systems: Lab 48, "Fruits and Seeds." Biological Science: An Inquiry into Life: Chapter 21, Inquiry 21-2, "From Seed to Seedling."
6.1 Describe the development of seeds and fruit.		
6.2 Describe the function of the fruit.	* Do a laboratory investigation of fruit and seeds.	Biological Science: An Introductory Study: Investigation 14-11, "Fruit."
6.3 Relate germination to some of the conditions which affect it, e.g., temperature, humidity.	Do lab on germination.	Addison-Wesley Biology: Laboratory Manual: Experiment 46, "Seed Germination."
7.0 Describe factors which cause malfunctions in plants. Discuss dehydration, mineral deficiencies, insects, diseases.		

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
7.1 Describe the significance of plant life in relation to the economy and the environment.	Discuss the environmental and economic significance of plants, e.g., plants as a food source or in terms of maintaining our air supply.	Biology: The Science of Life: Chapter 27, "Flowers--Three Pollination Stories"; Chapter 28, "Fruits, Seeds, and Seedlings." Biological Science: An Inquiry into Life: Chapter 20, "More Food for the World."

biology 300 (options)

UNIT DESIGN CHARTS FOR BIOLOGY 300 OPTIONS

OPTION A: TITLE: Anthropology TIME: 10 hours

RATIONALE: This option unit provides an examination of the process by which human beings have evolved. It strives to give the student a greater appreciation of the close links we have with all living creatures. By examining history in the anthropological sense, students can develop more positive attitudes to cultural differences. This knowledge can help them act and react in greater harmony with other members of our species and with the environment in general.

NOTE: The primary texts identified for the Biology 200-300 program do not deal with this option. A teacher selecting this option will require a variety of secondary and teacher references to successfully complete the option. Those marked with an asterisk will provide a good general coverage of the topic.

SECONDARY REFERENCES:

1. BSCS Blue Version. Biological Science: A Molecular Approach. Lexington, MA: D.C. Heath and Co., 1980.

2. BSCS Yellow Version. Biological Science: An Inquiry into Life. New York: Harcourt Brace Jovanovich, 1980.

TEACHER REFERENCES:

1. Slesnick, Irwin, et al. Biology. Glenview, IL: Scott Foresman and Co., 1980.

*2. Volpe, Peter E. Biology and Human Concerns. Third edition. Dubuque, IA: Wm. C. Brown Co., 1983.

*3. Leakey, Richard E. and Roger Lewin. Origins. New York: E.P. Dutton, 1977.

*4. Johanson, Donald and Edey Maitland. Lucy, the Beginnings of Humankind. New York: Simon and Schuster, 1981.

5. Wilson, P.J. Man, the Promising Primate. New Haven, CT: Yale University Press, 1980.

6. Emergence of Man, The Missing Link. Editors, Time-Life Books, 1973.
The First Men
The Neanderthals
Cro-magnon Man
The Birth of Writing

7. Edey, M.A. Three-Million-Year-Old-Lucy. Nature/Science Annual, Time-Life Books, 1976.

8. Johanson, Donald. Our Roots Grow Deeper. Science Yearbook, Worldbook Encyclopedia, 1979.

9. Geist, Valerius. Neanderthal the Hunter. Natural History, January 1981.

10. Washburn, S.L. "Evolution of Man." Scientific American, 1978.

AUDIO-VISUAL REFERENCES:

1. Filmstrip: "Evolution of Man" (set of six filmstrips from Ward's).

2. Film: "The Legacy of Leakey" (National Geographic films).

   "From Homo Erectus to Neanderthal"
   "Ape Men of Africa"
   "Who Discovered America"

   The above films are available from: Manitoba Education Film Service.

3. Available from Manitoba Education Film Service VTR "Life on Earth" Series:

   "Up-Right Man"
   "The Compulsive Communicators"

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
The student should be able to:		
1.0 Identify the difficulties faced by anthropologists in the practice of anthropology as a science.	Discuss the following statements about the difficulties inherent in the study of anthropology: - anthropology is largely interpretive rather than experimental; - anthropological hypotheses are difficult to test; - anthropological data are open to a wide variety of interpretations.	
1.1 Describe the contributions of and views on human origin held by some important anthropologists.	Examine the work of Dubois, Black the Leakeys, Dart, Washburn and Johnson, and the controversies tht surround their interpretations of their work.	Biology and Human Concerns: Chapter 41, "Emergence of the Human Species." Biological Science: An Inquiry into Life: Chapter 11, "Human Evolution."
2.0 Identify the main primate characteristics.	Study illustrations of various primates and compare their features with each other and with ourselves.	Biological Science: A Molecular Approach: Chapter 16. Biology and Human Concerns: Chapter 41, "Emergence of the Human Species." Biological Science: An Inquiry into Life: "Human Evolution."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
2.1 Identify the main primate groups.		Biological Science: An Inquiry Into Life: "Human Evolution."
2.2 Describe the general events in the evolution of primate types.	Discuss the role of diet, body size, and habitat in the development of primate traits.	Biology and Human Concerns: Chapter 41, "Emergence of the Human Species." Biological Science: An Inquiry into Life: "Human Evolution."
3.0 Describe the possible time of existence, range of occurrence, and mode of existence characteristic of the hominids found in the fossil record.	Use films or filmstrips if possible to illustrate the ecology of fossil hominids such as Australopithicus spp, Homo erectus, and Cro-magnon.	Biological Science: A Molecular Approach: Chapter 16, "The Human Species." Biological Science: An Inquiry Into Life: Chapter 11, "Human Evolution." Biology and Human Concerns: Chapter 41, "Emergence of the Human Species."
4.0 Discuss the role of culture and kinship in the success of humans to survive in a variety of environments.	Examine the traits of some cultures from different ecological environments and relate their habits to their ability to survive and the stress of their environment.	Biology and Human Concerns: Chapter 50, "Social Behavior."
5.0 Describe the methods used by anthropologists to investigate human origin.	Do an exercise in the interpretation of fragmentary evidence from an archeological site.	Biological Science: An Inquiry Into Life: Chapter 11, Inquiry 11-1, "Interpreting Evidence of Past Human Cultures."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
	Excavate an area such as an old refuse dump or unused building site as an exercise in the interpretation of artifacts.	
6.0 Identify the main factors in the cultural evolution of humans.	Discuss the effect of language, the use of fire, agriculture, tools, and the domestication of animals on human evolution.	Biological Science: An Inquiry Into Life: Chapter 11, "Human Evolution." Biology and Human Concerns: Chapter 41, "Emergence of the Human Species."
EXTENSIONS NOTE: The following extensions examine in depth some of the more recent developments in anthropology. They require a wider source of references and, in this light, a partial list of some of the more useful and recent publications is given at the beginning of this unit. Included are some suggested films.		
Fossil Analysis The student should be able to:		
1.0 Describe some of the more exotic ways in which fossil fuels and ancient habitats are analyzed.	Examine the following methods by which fossil fuels and ancient habitats are analyzed and discuss	

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
	the information gained from each method: - fission tracking - flouride level analysis - fossil pollen analysis - bone infrastructure analysis - protein stratigraphy - paleomagnetic shift analysis - soil particle analysis - recemization - potassium-argon analysis - tree-ring analysis - skeletal analysis - radiocarbon dating	
1.1 Describe the use of biochemical comparisons to interpret evolutional relationships.	Examine DNA and protein comparison studies as to their use in the study of human origins.	
<u>The Origin of Bipedalism</u> The student should be able to:		
1.0 Rank the relative importance of several environmental factors to the evolution of bipedalism.	Examine such factors as tool use, defence, change in habitat and sexual strategies in the origin of bipedalism.	<u>Lucy, the Beginnings of Humankind</u>: Chapter 16, "Is It a Matter of Sex?"

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
Origin and Evolution of Communication		
The student should be able to:		
1.0 Describe the significant events in the development of communication.	Discuss the fossil evidence used to judge the date when humans began using complex speech for communication. Investigate the steps that led to written communication.	
Social Order		
The student should be able to:		
1.0 Suggest possible events and factors that could lead to recognition of kinship.		Man, the Promising Primate
2.0 Describe the fossil evidence that shows the development of human interest in ritualism and spiritualism.		
Physical Anthropology		
The student should be able to:		
1.0 Identify the unique features of the human skeleton as compared to other primates.	Examine the changes of the human skull, spine, pelvis and limbs and suggest reasons for these developments.	The Missing Link
1.1 Suggest reasons for the evolution of these unique traits.		

OPTION B: TITLE: Histology TIME: 10 hours

RATIONALE: Histology is the branch of biomedical science in which scholars examine tissues in order to determine characteristics of normality and disease. This unit discusses the methods used in examining tissues, identifies normal tissues, and treats the significance of histology as a science.

PRIMARY REFERENCES:

1. Berry, Gordon S. Biology of Ourselves: A Study of Human Biology. Toronto: John Wiley and Sons, 1982.*

SECONDARY RESOURCES:

1. Evans, Williams F. Anatomy and Physiology. Third edition. New Jersey: Prentice-Hall Inc., 1983.
2. Cornett, F.D. and Pauline Gratz. Modern Human Physiology. Toronto: Holt, Rinehart and Winston, 1982.

TEACHER REFERENCES:

1. Bloom, W.D. and Don W. Fawcett. A Textbook of Histology. Toronto: W.B. Saunders Co., 1985.
2. Ross, Russell and Paul Bronstein. "Elastic Fibers in the Body." Scientific American (June 1971).
3. Slesnick, Irwin H., et al. Biology. Glenview, IL: Scott Foresman and Co., 1980.
4. Ham, Arthur W. Histology. Montreal: J.B. Lippincott Co., 1978.
5. Leeson, Roland C. Histology. Toronto: W.B. Saunders Co., 1976.

*Teacher references, as suggested in the unit, should be obtained.

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
The student should be able to:		
1.0 Define the term histology.	Examine prepared slides. Examine electron micrographs of cells.	Anatomy and Physiology: Chapter 3, "Cells and Tissues." Biology of Ourselves: A Study of Human Biology: Chapter 1, "Knowledge of the Human Body."
2.0 Describe how tissues are prepared for examination.	Discuss the preparation and examination of dead tissue. - fixation - embedding - sectioning - frozen section method	A Textbook of Histology: Chapter 1, "Histology and Cytology." Histology: Chapter 2, "How Histology is Studied." Histology: Chapter 1.
2.1 Contrast fixation and frozen section methods of preparation.	Demonstrate histological staining: - hematoxylin and eosin	
3.0 Describe and identify the following normal tissues: - epithelial - connective - nervous - muscle	Identify the following on prepared slides: Epithelium - simple squamous, stratified squamous - simple cuboidal - simple columnar, stratified columnar	A Textbook of Histology: Chapter 6, "Connective Tissue Proper"; Chapter 7, "Adipose Tissue"; Chapter 9, "Cartilage"; Chapter 10, "Bone"; Chapter 11, "Muscular Tissue"; Chapter 12, "Nervous Tissue."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
	Connective Tissue Proper - loose connective tissue Adipose Tissue - histological characteristics of adipose tissues Cartilage - hyaline and elastic cartilage Bone - macroscopic structure of bones - microscopic structure of bones Muscular Tissue - smooth, skeletal and cardiac muscle Nervous Tissue - neurons, neuroglia	Biology of Ourselves: A Study of Human Biology: Chapter 2. Modern Human Physiology: Chapter 4, "Intercellular Organization." "Elastic Fibers in the Body," Scientific American.
4.0 Describe an organ from a histological viewpoint.	Examine selected organs: (a) Skin - the epidermis - the dermis - hairs - nails	A Textbook of Histology: Chapter 4, "Glands and Secretions"; Chapter 13, "Blood and Lymph Vascular Systems"; Chapter 23, "Skin"; Chapter 27, "Intestines"; Chapter 30, "Respiratory System."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
	(b) Any hollow organ such as blood vessel, intestine, ureter. Visit the local histology lab. Invite guest speakers, e.g., - histology technologist - crime lab technician - pathologist - coroner Do labs: - examining autopsy slides for all topical areas listed above - examining Pap Smears - examining normal and cancer slides.	
5.0 Discuss the significance of histology.	Present reports on the use of histology for diagnostic purposes. Discuss the legal implications of histological reports. Interview a lawyer or pathologist.	
6.0 Evaluate careers in histology.	Careers - technologist - pathologist - coroner	

OPTION C: TITLE: Microbiology TIME: 10 hours (for each sub-option)

RATIONALE: Microbiology is that branch of science which has integrated the study of fungi, viruses, animal parasites and bacteria. Underlying all the applications of microbiology are certain fundamental facts and principles concerning the structure, mode of development and general physiological requirements and capabilities of microorganisms. This subject matter constitutes the groundwork of microbiology and is essential not only to a proper comprehension of the present practical applications of microbiology, but also to the further development of the science.

To complete this unit, the student may complete any one of the four sub-options:

1. Bacteriology
2. Mycology
3. Parasitology
4. Virology

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SUB-OPTION 1: Bacteriology

Bacteriology. The student may wish to select representative bacteria from the list provided from Objectives 7 to 14 inclusive. SPECIAL CAUTION MUST BE USED IN THE LABS.

SECONDARY REFERENCES:

1. BSCS Blue Version. Biological Science: A Molecular Approach. Lexington, MA: D.C. Health and Co., 1980.

2. BSCS Yellow Version. Biological Science: An Inquiry into Life. New York: Harcourt Brace Jovanovich, 1980.

3. Kaskel, Albert, et al. Laboratory Biology: Investigating Living Systems. Columbus, OH: Charles E. Merrill Publishing Co., 1979.

TEACHER REFERENCES:

* 1. Smith, Alice L. Microbiology and Pathology. Fourth edition. St. Louis: C.V. Mosby, 1980.

2. Beisher, L. Microbiology in Practice. San Francisco: Canfield Press, 1974.

* This book is recommended as a basic teacher reference.

3. Stanier, R. and M. Dondoroff. The Microbial World. Englewood Cliffs, NJ: Prentice-Hall, 1976.

4. Smith, Alice L. Microbiology Laboratory Manual and Workbook. Seventh edition. St. Louis: C.V. Mosby, 1977.

5. Bullock, Barbara L. Pathophysiology. Toronto: Little Brown and Co., 1984.

6. Edmonds, Paul. Microbiology--An Environmental Perspective. New York: Macmillan Co., 1978.

7. Raphael, Stanley S. Lynch's Medical Laboratory Technology. Toronto: W.B. Saunders, 1983.

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
The student should be able to:		
1.0 Describe the basic classification system for microorganisms.	Recall basic classification and criteria for determination of classification.	Refer to Biology 200 option, "Disease-Causing Organisms in Humans."
2.0 Describe the morphology, cell structure and growth of bacteria.	Observe and describe the size, morphology, shapes and structure of individual and groups of bacterial cells. Examine and describe colonial morphology--types of bacteria.	Microbiology Lab Manual and Workbook: Lab 6, "Cultivation and Colonial Bacteria."
3.0 Describe safe laboratory methods used to culture bacteria.	Describe or perform the following lab activities: (CAUTION) - culture of bacteria - methods of obtaining pure cultures	Microbiology and Pathology: Unit 11, "Microbes: Procedures for Study." Microbiology Laboratory Manual and Workbook: Labs 5, 6, 7, 8. Microbiology in Practice: Part II, "Basic Microbiological Techniques." The Microbial World: Chapter 9, "Microbial Growth."
4.0 Describe methods of controlling the growth of bacteria.	Describe the action of physical agents such as temperature and drying on bacteria.	Laboratory Biology: Investigating Living Systems: Lab 46, "Using Antibiotics to Stop Bacterial Growth." Microbiology and Pathology: Unit 4, "Microbes, Preclusion of Disease."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
	Describe the effects of chemical agents such as bactericidal substances (disinfectants) and chemotherapeutic drugs, e.g., synthetic compounds--the sulfones and antibiotics.	The Microbial World: Chapter 9. Microbiology Laboratory Manual and Workbook: Lab 18, "Effects of Physical Agents on Bacteria"; Lab 19, "Effects of Chemical Agents on Bacteria"; Lab 20, "Testing Efficiency of Sterilization Procedures." Microbiology in Practice: Part I, "Use of Equipment"; Parts II and III, "Chemical and Physical Effects on Bacteria."
5.0 Identify Gram-negative and Gram-positive bacteria. 5.1 Prepare a bacteriological smear. 5.2 Perform a Gram stain.	Examine prepared slides. Make smears of available bacteria and stain them (CAUTION), e.g., - prepare a throat swab - prepare a smear and culture of an unknown organism and identify it	Microbiology Laboratory Manual: Activity 10B, "Staining Bacteria." Microbiology and Pathology: Unit 2. The Microbial World: Chapter 5, "The Eubacteria." Microbiology Laboratory Manual and Workbook: Lab 3, "Microscopic Appearance of Bacteria--Staining"; Lab 12, "Source of Infection." Microbiology in Practice: Part 4, "Bacterial Stains"; Lab 48, "Throat Culture."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
6.0 Categorize bacteria using correct nomenclature.	Identify selected bacteria on prepared slides, transparencies and photomicrographs.	Microbiology in Practice: Table 53-1, "Selected Characteristics of Some Bacteria as Unknowns." Microbiology and Pathology: Chapter 1, "Definition and Dimensions." The Microbial World: Chapter 15, "The Classification of Bacteria."
7.0 Describe characteristics of some strains of bacteria.	Examine prepared slides of staphylococcus to learn about morphology and staining. Discuss the relative pathogenicity of bacteria species on the basis of coagulase test.	The Microbial World: Chapter 21, "Gramp-positive Eubacteria." Microbiology and Pathology: Chapter 18, "Gramp-positive Pyogenic Cocci." Microbiology Laboratory Manual and Workbook: Lab 21, "Cocci." Microbiology in Practice: Lab 43, "Pathogenic Staphylococus Aureus."
8.0 Describe characteristics of the enteric bacilli.	Observe slides of: - coliform bacteria - proteus sp. - salmonella group - typhoid bacilli - dysentery bacilli Report on pathogenicity of these organisms.	The Microbial World: Chapter 27. Microbiology and Pathology: Chapter 20, "Gram-negative Enteric Bacilli." Microbiology Laboratory Manual and Workbook: Lab 23, "Enteric Bacteria."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
		Microbiology in Practice: Lab 42, "Intestinal Pathogens and the Family Enterobacteriaceae." Film: "An Outbreak of Salmonella."
9.0 Describe characteristics of the Clostridia sp.--the spore-forming anaerobes.	Examine prepared slides and reference material to describe: - Clostridium tetani - tetanus toxin - Clostridium botulinum Relate the cultural characteristics of the Clostridium sp. to their pathogenicity. Prepare a report on immunity against tetanus.	Microbiology in Practice: Lab 16, "Cultivation of Anaerobes." Microbiology Laboratory Manual and Workbook: Lab 8E, "Anaerobes." Microbiology and Pathology: Lab 22, "Anaerobes in Disease"; Chapter 36, "Biologic Products for Immunization." The Microbial World: Chapter 20, "The Endospore Forming Bacteria."
10.0 Describe characteristics of mycobacterium.	Use prepared slides to compare the tubercle bacilli and the bacilli of leprosy. Prepare a report on prevention and treatment.	Microbiology in Practice: Lab 27, "Acid-Fast Stain." Microbiology and Pathology: Lab 24, "Acid-Fast Bacteria and Spirochetes." Microbiology and Pathology: Chapter 25, "Acid-Fast Mycobacteria."
11.0 Compare careers in microbiology with those in histology.	Vist a microbiology lab.	

SUB-OPTION 2: Mycology

PRIMARY REFERENCES:

1. Rahn, Joan E. Biology: The Science of Life. Second edition. New York: Macmillan Publishing Co., Inc., 1980.

2. Kaskel, Albert, et al. Laboratory Biology: Investigating Living Systems. Columbus, OH: Charles E. Merrill Publishing Co., 1979.

REFERENCES AND RESOURCES (TEACHERS):

1. Principles and Practices of Commercial Farming. Fifth edition. Faculty of Agriculture, University of Manitoba Yearbook, Manitoba Department of Agriculture, 1977.

2. Alexopoulos. Introductory Mycology. Second edition. New York: John Wiley and Sons, Inc., 1978.

3. Smith, Alice L. Microbiology and Pathology. St. Louis: C.V. Mosby, 1980.

4. Slesnick, Irwin H., et al. Biology. Glenview, IL: Scott Foresman and Co., 1985.

5. Raphael, Stanley S. Lynch's Medical Laboratory Technology. Toronto: W.B. Saunders Co., 1983.

6. Bullock, B.L. Pathophysiology. Toronto: Little, Brown and Co., 1984.

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
1.0 Use a microscope to identify spores, sporangium, hypha and mycellium of fungi. 1.1 Describe the function of each of the above structures. 1.2 Distinguish between an obligate parasite and an obligate saprophyte. 1.3 Diagram a life cycle, e.g., Puccinia graminis. 1.4 Culture and identify molds in the laboratory or in the field, weather permitting.	Examine prepared slides and photomicrographs of selected fungi. Examine slides and illustrations of various fungi.	Microbiology and Pathology: Chapter 30, "Fungi, Medical Mycology." Laboratory Biology: Investigating Living Systems: Lab 44, "Fungal Nutrition." Microbiology in Practice: Lab 29, "Filamentous Guns." Medical Laboratory Technology: Chapter 23. Pathophysiology: Chapter 7. Microbiology and Pathology: Chapter 30.
2.0 Differentiate between a fungal, viral and bacterial disease. 2.1 List the symptoms and methods of treatment for the common fungal diseases of humans--Tinea's, Candida albicans and aspergilliosis.	Discuss the causative agent, course and treatment of the following fungal pathogens in humans: - Candida sp. - Dermatophytes - Aspergillus sp. - Actinomycetes	

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
3.0 Diagram the life cycle of wheat rust. 3.1 List methods of control of wheat rust. 3.2 Diagram the life cycle of corn smut. 3.3 List methods of control of corn smut. 3.4 Describe the importation of Dutch elm disease. 3.5 Diagram the life cycle of Dutch elm disease. 3.6 List possible methods of control of Dutch elm disease. 3.7 Compare economic costs of fungal diseases of humans to fungal diseases of plants.	Discuss the causatory agent, course and treatment of the following fungal diseases of crops: - wheat rust (Puccinia graminis) - corn smut (Ustilago maydis) - ergot of rye (Claviceps purpurea) - Dutch elm disease (Ceratocystic ulmi)	Laboratory Biology: Investigating Living Systems: Lab 75, "A Yeast Population Study"; Lab 11, "Factors Influencing Rate of Yeast Respiration."
4.0 Describe the atypical nature of yeast. 4.1 Write the equation for anaerobic respiration.	Examine prepared slides of yeasts. Do labs to demonstrate physiology of yeasts.	

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
	Visit a bakery, brewery or mushroom farm.	
4.2 Describe the importance of yeast to the brewing and baking industries.		Biology: The Science of Life: Chapter 12, "Respiration: The Chemistry of Respiration: Aerobic, Anaerobic, Fermentation."
4.3 Name and identify several edible fungi, e.g., morels, truffles, blue cheese.		
4.4 Define antibiotics and describe the discovery of penicillin.	Examine the structure of a mushroom.	
4.5 Discuss the fungi as sources of hallucinogens.		
Careers - technologist - mycologist - microbiologist - mushroom farm worker - pharmacist - sewage plant operator		

SUB-OPTION 3: Parasitology

PRIMARY REFERENCES:

1. Berry, Gordon S. Biology of Ourselves: A Study of Human Biology. Toronto: John Wiley and Sons, 1982.

SECONDARY REFERENCES:

1. Smith, Alice L. Microbiology and Pathology. St. Louis: C.V. Mosby, 1980.
2. Smith, Alice L. Microbiology Laboratory Manual and Workbook. St. Louis: C.V. Mosby, 1980.
3. Beisher, L. Microbiology in Practice. San Francisco: Canfield Press, 1974.
4. Slesnick, Irwin H., et al. Biology. Glenview, IL: Scott Foresman and Co., 1985.
5. Raphael, Stanley S. Lynch's Medical Laboratory Technology. Toronto: W.B. Saunders Co., 1983.
6. Bullock, B.L. Pathophysiology. Toronto: Little, Brown and Co., 1984.

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
The student should be able to: 1.0 Define the terms: - parasitology - ectoparasites - endoparasites		

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
2.0 Describe the structure and pathogenicity of the spirochetes.	Describe the causative agent, course and treatment of the following diseases: - Vincent's angina - syphilis (Treponema pallidum)	Microbiology and Pathology: Chapter 23, "Spirochetes and Spirals." Biology of Ourselves: A Study of Human Biology: Chapter 18, "Changes in the Reproductive System." See option on STDs.
3.0 Describe parasites common to humans. 3.1 Identify ova and adults of the selected parasites. 3.2 Describe trypanosomes. 3.3 Describe the life cycle of one parasite.	Using prepared slides and other reference materials, identify: - protozoa--e.g., Amoeba sp. - Plasmodium sp. - hemoflagellates--e.g., Trypanosomes; - trematoda--e.g., blood flukes - cestoda--e.g., Taenia sp. Echinococcus sp. - nematoda--e.g., Enterobius sp. (hookworms)	Microbiology and Pathology: Chapter 31, "Protozoa--Medical Parasitology"; Chapter 32, "Metazoa, Medical Helminthology." Microbiology Laboratory Manual and Workbook: Lab 27, "Protozoa." Microbiology in Practice: Part 5, "Characteristics of Other Selected Organisms." Guests--meat inspector, public health worker.
3.4 Describe the effects of parasites on the economy of a selected area and give potential biological solutions.	Do library research on malaria, hookworms, dysentary. For example, examine the effect of the Aswan Dam upon schistomosis.	

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
4.0 Describe careers in parasitology.	Research the following careers: - meat packing inspector - plant parasitologist - medical technologist - veterinary technologist	

SUB-OPTION 4: Virology

PRIMARY REFERENCES:

1. BSCS Blue Version. Biological Science: A Molecular Approach. Fourth edition. Boulder, CO: D.C. Heath and Co., 1980.

TEACHER REFERENCES:

1. Slesnick, Irwin H., et al. Biology. Glenview, IL: Scott, Foresman and Co., 1985.
2. Edmonds, Paul. Microbiology: An Environmental Approach. New York: Macmillan Publishing Co., Inc., 1978.
3. Raphaels, Stanley. Lynch's Medical Laboratory Technology. Toronto: W.B. Saunders Co., 1983.
4. Bullock, B.L. Pathophysiology. Toronto: Little, Brown and Co., 1984.
5. Smith, Alice L. Microbiology and Pathology. St. Louis: C.V. Mosby, 1980.

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
The student should be able to:		
1.0 Describe the structure of viruses. 1.1 Describe the reproduction of viruses. 1.2 List ways viruses affect humans and other living things. 1.3 Describe defences against viral infections.	Using photomicrographs and reference materials, prepare a report on: - the physical character of viruses; - the effect of physical and chemical agents on viruses; - reproduction of viruses; - drug therapy in viral disease; - immunity in viral infections.	Microbiology in Practice: Chapter 28, "Viruses"; Chapter 29, "Viral Diseases"; Chapter 36, "Biologic Products for Immunization." Biology: Chapter 11, "Viruses and Monerans." Biological Science: A Molecular Approach: Chapter 8.

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
1.4 Describe the effects of viral infections.		Pathophysiology: Section II, Unit IV.
1.5 Differentiate bacterial and viral conditions.		Microbiology: An Environmental Approach: Chapter 1.
2.0 Describe viral diseases of humans.	Compare the etiological agent and the cause of the following viral diseases of humans: - smallpox - vaccinia - measles - rubella - Varicella sp. (chicken pox) Herpes zoster (shingles) Herpes type II - influenza - the common cold - infectious mononucleosis - poliomyelitis	Microbiology in Practice: Chapter 29. Lynch's Medical Laboratory Technology: Chapter 24.
3.0 Describe bacteriophage (the bacterial viruses).	Compare phages and bacteria: - characteristics of bacteriophage; - effect of phage on bacteria; - therapeutic use of phage.	Microbiology and Pathology: Chapter 28. Pathophysiology: Section II, Unit IV. Microbiology: An Environmental Perspective: Chapter 1.

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
4.0 Compare careers in virology and microbiology.	Prepare a report on the following careers: - medical technologist - virologist - public health nurse - public health worker	Bring in a guest speaker.

OPTION D: TITLE: Health Care and Health TIME: 10 hours

RATIONALE: The health services industries are a major employer in Canada, with capital and running costs totalling billions of dollars per annum. Production of health care products is a multi-million-dollar industry. It is important that we understand the ways in which health care systems work and that we analyze the cost-benefit balance of medical services. Health care industries rely heavily on biological research. This unit examines the history of medicine and investigates its social and financial effect on our lives.

PRIMARY REFERENCES:

*1. Lewis, John L. Science in Society: Teacher's Guide; Medicine and Care: Book C (10 copies/class of 20); Simulations: Dental Health Project OR Marimbian Health Service Project; Science and Society: Diseases and the Doctor Book A; Science and Society: Population and Health Book B. London: Heinemann Educational Books, 1981. (Canadian Representative: The Book Society of Canada Limited, Agincourt, ON).

These books are useful as reference for this unit and for units on population, cancer, heart disease and other disease.

TEACHER REFERENCES:

*1. Lewis, John L. Science in Society: Teacher's Guide. London: Heinemann Educational Books, 1981. (Canadian Representative: Book Society of Canada Limited, Agincourt, ON.)

2. Stine, William R. Applied Chemistry. Second edition. Boston: Allyn and Bacon Inc., 1978. This provides useful information about dental caries and fluoridation, immunochemistry, chemotherapy and other medical phenomena. Depending upon the choice of options within the chemistry program, copies may be available.

3. Caliendo, Mary Alice. Nutrition and Preventive Health Care. New York: Macmillan Publishing Co., Inc., 1981.

4. Lalonde, Marc. A New Perspective on the Health of Canadians: A Working Document. Ottawa: Information Canada, 1975.

* This guide is also used in options for the Physics 300 program.

5. Kimball, John W. Man and Nature: Principles of Human and Environmental Biology. Menlo-Park, CA: Addison-Wesley Publishing Co., Inc., 1975.

6. Skoll, S.L. Adding Life to Years. Regina: Government of Saskatchewan, 1976.

AUDIO-VISUAL REFERENCES:

1. Unseen Enemies
   The Rival World
   These films are available from Shell Film Library, Box 400, Terminal A, Toronto, Ontario.

2. Effective Thinking: Ways of Problem Solving
   Clear Thinking: How to Use Your Reasoning Skills
   These slide-tape materials are available from The Centre for Humanities Inc., Box 1000, Mount Kisko, NY.

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
The student should be able to:		
1.0 Place modern medical procedures in an historical context.	Discuss the contributions of Harvey, Lister, Jenner, Koch, Erhlich, Pasteur, Fleming, Banting and Best, Salk and Sabin, and Bernard to the development of modern medical practice.	Science in Society: Medicine and Care: Chapters 1 and 2.
2.0 Describe the roles of various practitioners in the area of health care, e.g., surgeons, family practitioners, nurses, licensed practical nurses, orderlies, pharmacists, labora-	Prepare a detailed report on the contributions of several of the above researchers.	Science in Society: Diseases and the Doctor.

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
tory technologists, physio and occupational therapists, dental surgeons, dentists, dental nurses, oral hygienists, opthalmologists, chiropractors, nutritionists.		
3.0 Discuss the personal and societal rationale for and consequences of specific medical procedures.	Investigate the purpose, cost and consequences, to the individual and society, of some of the following: an office visit to a family physician for an annual check up, a follow-up visit to a specialist, the delivery of a baby, an appendectomy, major surgery such as a bypass or transplant, a dental extraction, a root canal, orthodonic treatment, a complete blood test, a urinalysis.	Science in Society: Medicine and Care
4.0 Evaluate the costs and benefits of specific aspects of medical care.	Apply the decision-making model outlined on pages 59-64 of this guide to evaluate one or more of the following: fluoridation of water, kidney dialysis, organ transplants, immunization programs, socialized versus private medicine, salary differentials in health care.	Science in Society: Dental Health Project or Marimbian Health Service Project

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
5.0 Distinguish between degenerative diseases, infectious disease and trauma. 5.1 Distinguish between preventive and therapeutic medicine. 5.2 Discuss how the adoption of a particular lifestyle can affect one's health and thus the cost of medical and health care.	Investigate the personal and social consequences of disease, arthritis, cancer, heart disease, flu, pneumonia, polio, car accidents, industrial and home accidents.	Science in Society: Diseases and the Doctor and Population and Health

OPTION E: TITLE: Plants and Agriculture* TIME: 10 hours

RATIONALE: Any organized community with a stable economy and which supports a large growing population is dependent on some kind of agricultural industry to supply food and clothing for tht community. Significant cultural development of a civilization depends upon permanent settlement, which depends on a sure supply of food and clothing, which in turn depends upon agriculture. The early civilizations of China and Egypt arose shortly after the development of agriculture, that is, about 6000 B.C.

Agriculture now, as it was in the past, is the technology which makes most other technologies possible. It is the efficiency of its agricultural systems which allows a nation enough wealth to indulge in esoteric forms of research. The study of new approaches and research in plant science may not be as appealing to students as the study of the latest findings in human genetics, for example, might be, but agricultural development will probably have a far more significant effect on their lives than will developments in human biology. For this reason, both rural and urban students should be exposed to basic agricultural practices and also to new developments in agriculture.

PRIMARY REFERENCES:

1. Rahn, Joan E. Biology: The Science of Life. Second edition. New York: Macmillan Publishing Co., Inc., 1980.

SECONDARY REFERENCES:

**1. Agriculture Canada. "Tomato Diseases" 1479
"Ergot of Grasses and Grains" 1438
"Canola" 56
"Diseases and Pests of Potatoes" 1492

TEACHER REFERENCES:

**1. Kimball, John W. Man and Nature: Principles of Human and Environmental Biology. Menlo Park, CA: Addison-Wesley Publishing Co., 1975.

2. Southwick, C.H. Ecology and the Quality of Our Environment. Toronto: Van Nostrand Co., 1976.

* The Chemistry of Agriculture is a option in Chemistry 300. Teachers may wish to examine how the two units can support each other.
**Useful references.

3. National Geographic. "The Pesticide Dilemma," vol. 157, no. 2 (February 1980).

4. Science and Society: Agriculture. Agincourt: The Book Society of Canada, 1981.

5. Principles and Practices of Commercial Farming. Faculty of Agriculture, University of Manitoba, 1977.

6. Jarvis, Bruce and Paul Mozzocchi. Form and Function: An Organic Chemistry Module. New York: Harper and Row, 1981.

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
The student should be able to:		
1.0 Describe the structure of a root, stem, leaf and flower.	Briefly review plant anatomy as covered in the unit, Angiosperms.	See references in the unit, Angiosperms.
1.1 Write the summary equation for photosynthesis.	$6CO_2 + 6H_2O \xrightarrow[\text{energy}]{\text{radiant}} C_6H_{12}O_6 + 6O_2$	
2.0 Diagram the carbon, nitrogen and phosphate cycles.	Trace through the events of the carbon, nitrogen and phosphate cycles stressing the critical role of autotrophs and bacteria.	Man and Nature: Principles of Human and Environmental Biology: Chapter 10, "Materials Cycles."
2.1 List the major uses of carbon, nitrogen and phosphates by plants.	Grow plants in varying chemical conditions.	Biology: The Science of Life: Chapter 13, "Cycles of Matter."
2.2 Compare the acquisition and use of these chemicals by plants and animals.		Commercial Farming: Chapter 4, "Soil, Fertility Practices"; Chapter 3, "Soils."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
3.0 Name the three major components of fertilizer and relate these three nutrient cycles (carbon, nitrogen, phosphate) to each other.	Bring in labels from a variety of fertilizers (for lawns, cereal crops, etc.) and discuss the significance of the ratio given on the labels.	Principles and Practices of Commercial Farming: Chapter 4, "Soil, Fertility and Fertilizer Practices."
3.1 Distinguish between a pesticide, a herbicide, an insecticide, a selective weed killer, and a soil sterilant. Give an example of each.	Select a specific chemical or group of chemicals (e.g., DDT, fertilizers), and research or discuss the positive and negative effects of various degrees of use.	Principles and Practices of Commercial Farming: Chapter 8, "Weeds, Plant Diseases and Insects." Agriculture Canada Publications Science in Society: Agriculture: Chapter 4, "Agriculture and the Environment." Man and Nature: Principles of Human and Environmental Biology: Chapter 21, "The Struggle for Existence: Competing for Food." Ecology and the Quality of Our Environment: Chapter 12, "Pesticide Contamination and Herbicide Contamination."
3.2 Weigh the consequences of increased use versus desired results of the use of chemicals in agriculture.	Collect and examine data that relate fertilizer use to crop yield, or insecticide use to insect pest problems.	Science in Society: Agriculture: Chapter 4. Man and Nature: Principles of Human and Environmental Biology: Chapter 21, "The Struggle for Existence: Competing for Food."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
3.3 Examine the pros and cons of specific agricultural practices and relate these to agriculture success.	Discuss such practices as monoculture, stubble-burning, zero tillage, irrigation, organic farming, and slash and burn. Examine the limitations of each and the circumstances under which each could be used.	Principles and Practices of Commercial Farming: Chapter 18, "Irrigation"; Chapter 5, "Special Crops." Man and Nature: Principles of Human and Environmental Biology: Chapter 21.
4.0 Distinguish between a fungus, a bacterium, a nematode and an insect.	Collect soil samples and identify examples of bacteria and fungi using microbiological methods. Collect the insects and nematodes present using a Burlese funnel.	
4.1 Describe the methods that can be used to control agricultural pests and explain the physiology of their effect.	Discuss the use of biological and chemical controls of insects. Find out which methods are most commonly used. Find out why chemicals are the most common method used to control pests. Discuss the effectiveness of chemicals.	National Geographic, "The Pesticide Dilemma." Ecology and the Quality of Our Environment: Chapter 2, "Pollution." Form and Function: An Organic Chemistry Module: "Chemical Warfare in the Animal World"; "Pesticides and Sex Attractants."
4.2 Describe the dangers to the environment and to humans which result from the use of some of the methods used to control agriculture pests.		National Geographic, "The Pesticide Dilemma." Ecology and the Quality of Our Environment: Chapter 2, "Pollution."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
5.0 Identify the factors involved in a selected aspect of the politics of food production.	Examine such issues as: . the use of wheat as a weapon; . the foreign ownership of Manitoba farmland; . overpopulation and famine; . food pricing and the economics of farming; and . habitual destruction and the loss of plant varieties.	
5.1 Discuss the advantages and disadvantages of absentee farm ownership.	Collect data on foreign ownership for the local region and compare to provincial statistics.	
5.2 State the requirements that must be met under provincial and local laws for foreigners to own Manitoba land.	Identify the attitudes of local residents to foreign ownership. Construct and conduct a survey of local residents on this subject.	
6.0 Describe briefly the recent advances being made in agricultural practices.	Examine such developments as the production of gasohol, hydroponics, farming the sea, genetic engineering. Field trip to Minnedosa gasohol plant, modern research station, or fertilizer plant.	
6.1 Describe the requirements for and duties of some occupations related to agriculture.	Examine some occupations related to farming, such as: . horitculturalist . agricultural researcher . agricultural representative agricultural supplies salesperson	

OPTION F: TITLE: Origin and Evolution of Life TIME: 10 hours

RATIONALE: The use of the term theory by scientists often leads to misunderstanding and confusion by the general public. A study of evolution can give students a better understanding of the scientific meaning of the term as well as a basis on which to interpret the variety in form and organization of living organisms. Although the question concerning the origin of life is separate from that of evolution, the two phenomena are often closely linked in discussion, and an investigation of the theories of the origin of life enable the student not only to become familiar with the physical and chemical conditions necessary for life but also to examine how a scientific theory is formulated and tested. This unit provides an excellent framework for examining the interaction of science, society and technology in the context of important developments in the scientific world.

PRIMARY REFERENCES:

1. Rahn, Joan E. Biology: The Science of Life. Second edition. New York: Macmillan Publishing Co., Inc., 1980.

2. Kaskel, Albert, et al. Laboratory Biology: Investigating Living Systems. Columbus, OH: Charles E. Merrill Publishing Co., 1979.

TEACHER REFERENCES:

1. BSCS Blue Version. Biological Science: A Molecular Approach. Lexington, MA: D.C. Heath and Co., 1985.

2. BSCS Yellow Version. Biological Science: An Inquiry into Life. New York: Harcourt Brace Jovanovich, 1980.

*3. Stanley, Steven. The New Evolutionary Timetable. Basic Books Inc., 1981.

4. Volpe, Peter E. Biology and Human Concerns. Third edition. Dubuque, IA: Wm. C. Brown Co., 1983.

5. Attenborough, David. Life on Earth. Boston: Little, Brown and Co., 1979.

*Essential reference.

6. Sagan, Carl. Cosmos. New York, NY: Random House, 1980.

7. Ponnamperuma, Cyril. The Origins of Life. First edition. New York, NY: E.P. Dutton and Co., 1972.

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
The student should be able to:		
1.0 Describe the theory of spontaneous generation and give some "examples" of it.	Do a demonstration lab to simulate the experiments of Pasteur dealing with the origin of life.	Addison-Wesley Biology: Chapter 21, "Change Over Time." The Origins of Life: Chapter 1, "The Beginning." Biological Science: A Molecular Approach: Chapter 5, "Forerunners of Life"; Investigation 5-A, p. 591, "Where Do Bacteria and Other Microorganisms Come From?" Biological Science: An Inquiry into Life: Chapter 1, "Investigating the Living World."
1.1 Describe and compare the works of Redi, Needham, Spallanzani, Pouchet and Pasteur to disprove the theory of spontaneous generation.		
2.0 Give a scientific hypothesis for the formation of planets such as the earth.	Discuss the results of experiments and observations conducted by astronomers and interplanetary space reserchers that have helped us understand the earth's origins.	Cosmos The Origins of Life: Chapters 2-6. Biology: The Science of Life: Chapter 45, "Development of Life on Earth."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
2.1 List the probable components of the earth's original atmosphere.		Biological Science: A Molecular Approach: Chapter 3, "Forerunners of Life."
2.2 Describe the mechanisms by which organic compounds could have been produced under original earth conditions.		Biological Science: An Inquiry into Life: Chapter 12, "Diversity in the Living World."
2.3 Describe how the heterotroph hypothesis explains the origin of life on earth.		Biological Science: A Molecular Approach: Chapter 4, "Forerunners of Life."
2.4 Compare the structures of "l" and "d" isomers to their functions.	Discuss the structures of isomers and relate the presence of isomers in living cells to their structures.	The Origins of Life: Chapter 7, "Polymers"; Chapter 9, "Right-Handed and Left-Handed Molecules."
2.5 Describe the findings of Murchison. Discuss the significance of his findings.		The Origins of Life: Chapter 13, "Organic Matter in Meteorites."
2.6 State the significant aspects of the cell symbiosis hypothesis.		Biological Science: A Molecular Approach: Chapter 10, "The Cell Theory."
		Biology and Human Concerns: Chapter 39, "Origin of Life and Molecular Evolution."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
2.7 Describe how the development of photosynthesis affected the earth's atmosphere and evolutionary conditions.		The Origins of Life: Chapter 3, "The Raw Material."
3.0 Define the terms species, gene pool, variation and adaptations.	Do a lab on animal adaptations.	The New Evolutionary Timetable Biology and Human Concerns: Chapter 37, "Races and Species." Laboratory Biology: Investigating Living Systems: Lab 4, "Animal Adaptation."
3.1 Describe the historical development of the concept of evolution.	Examine the contributions of Cuvier, Lamarck, Lyell, Darwin, Wallace, Dobzhansky, Mayr and Eldredge to the concept of evolution.	Origins: Chapter 2, "The Greatest Revolution."
4.0 Identify the experiences and observations of Darwin that convinced him that evolution occurred.		The New Evolutionary Timetable: Chapter 2, "The Voyage Toward Evolution"; Chapter 3, "The 'Origin' and its Very Slow Process."
4.1 Describe the mechanism of natural selection according to Darwin.	Do a lab on the effect of selection on population characteristics.	Biological Science: An Inquiry into Life: Chapter 9, Inquiry 9-1, "Natural Selection." Biology and Human Concerns: Chapter 29, "Darwinian Scheme of Evolution."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
4.2 Discuss the factors that influenced Darwin in arriving at his interpretation of the process of evolution.	Discuss the influences of Lyell, the concept of plenitude, skepticism of the fossil record, the perfection of organs and his belief in the sparsity of variation on Darwin's analysis.	The New Evolutionary Timetable: Chapter 2, "The Voyage Toward Evolution"; Chapter 3, "The 'Origin' and Its Very Slow Process."
5.0 Describe the mechanism of punctuated equilibrium as it applies to the process of evolution.		The New Evolutionary Timetable: Chapter 6, "On the Rapid Origin of Species,"; Chapter 5, "The Fossil Record, Our Window to the Past."
5.1 Compare natural selection/ gradualism to punctuated equilibrium and identify the differences.		Biology and Human Concerns: Chapter 32, "Concept of Selection."
5.2 Cite evidence that points to the punctuated equilibrium model of evolution.		
6.0 Specify potential roles of mutation, genetic recombination, isolation, migration and genetic drift, evolution of new species and species multiplication.	Do a lab on the principles of population genetics.	The New Evolutionary Timetable Biological Science: A Molecular Approach: Chapter 15, "Origin of New Species." Biological Science: An Inquiry into Life: Chapter 10, "Evolution at Work"; Chapter 10, Inquiry 10-1, "Population Genetics and Evolution."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
		Biology and Human Concerns: Chapter 35, "Genetic Drift and Gene Flow"; Chapter 30, "Genetic Variation and Mutation."
6.1 Compare the evolutionary results of divergence, convergence, adaptive radiation and progressionism.		The New Evolutionary Timetable: Chapter 6, "On the Rapid Origin of Species"; Chapter 7, "Human Origins." Biological Science: An Inquiry into Life: Chapter 9, "Change Through Time--Evolution." Biology and Human Concerns: Chapter 38, "Adaptive Radiation."
7.0 Describe the techniques used by paleobiologists to analyze the fossil record.	Explain such techniques as stratigraphy, radiometric dating, DNA pairing, immunological comparisons, protein racemization and O^{18} uptake as used in studying the fossil record. Do a lab on protein analysis.	Laboratory Biology: Investigating Living Systems: Lab 39, "Biochemical Evidence of Evolution."
8.0 Identify the major geological eras used to describe the fossil record.	Have students construct large calenders comparing the earth's history to one year on which they plot the major events and geological eras.	Life on Earth Cosmos

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
8.1 Identify the sequence of major evolutionary events as currently shown by the fossil record.	Refer to activity for 8.0.	Life on Earth Cosmos
EXTENSIONS		
The Hardy-Weinberg Principle		
The student should be able to:		
1.0 State the Hardy-Weinberg Law.		Addison-Wesley Biology: Laboratory Manual: Experiment 53, "Population Dynamics."
1.1 Use the law to predict genotype and phenotype ratios.	Do a lab to demonstrate the properties of population equilibrium.	Biology and Human Concerns: Chapter 31, "Concept of Genetic Equilibrium."
1.2 List the conditions under which the law applies.		Biological Science: An Inquiry into Life: Chapter 10, "Evolution at Work"; Inquiry 10-1, "Population and Genetics."
		Biological Science: A Molecular Approach: Chapter 15, "Origin of New Species"; Investigation 15, "Origin of New Species."
		The New Evolutionary Timetable: Chapter 8, "Continuity or Creation."

OPTION G: TITLE: The New Genetics: An Issues Approach TIME: 10 hours

RATIONALE: The thrust of genetic engineering and much genetic research is currently directed toward genetic screening, that is, the identification of those individuals with genetic defects or who may pass deleterious genes on to their offspring. Genetic screening is a relatively recent phenomenon, analysis of chromosome defects date to the 1950s, and screening for biochemical defects such as galactosemia and phenylketonuria date to the same period. The fact that scientists can now detect genetically defective fetuses in utero and have developed procedures to detect heterozygous carriers of genetic diseases raises moral, ethical and political problems. This unit is designed to focus on some of the recent advances in genetics and molecular biology and to encourage discussion of the issues that they raise.

NOTE: The "New Genetics" is only one of the many topics that can be taught using an "issues" approach as outlined in pages 59-64 of this guide.

PRIMARY REFERENCES:

1. Volpe, Peter E. Biology and Human Concerns. Third edition. Dubuque, IA: Wm. C. Brown Co., 1983. (Teacher reference.)

2. Any one of the sound-slide programs (numbers 3-5) listed under audio-visual references can be used to develop objectives 3.1 and 3.2.

* 3. BSCS. Human Genetics. Dubuque, IA: Kendall/Hunt Publishing Co., 1983.

OR

* 4. BSCS. Science, Technology and Society (student's, teacher's guide).
BSCS. Biomedical Technology (student's, teacher's guide).
BSCS. Human Reproduction: Social and Technological Aspects (student's, teacher's guide).
Dubuque, IA: Kendall/Hunt Publishing Co., 1984.

TEACHER REFERENCES:

1. CRM. Biology: An Appreciation of Life. Del Mar, CA: Communications Research Machines, Inc., 1972.

2. Cusimano, V.J. and S. Halpern. Contemporary Issues in Science: Implementation Manual. Staten Island, NY: The Staten Island Continuum of Education, Inc., 1982.

3. Iozzi, L.A., et al. Dilemmas in Bioethics. New Brunswick, NJ: Institute for Science, Technology and Social Education. The Center for Coastal and Environmental Studies. Rutgers: The State University of New Jersey, Doolittle Hall, 1980.

4. March of Dimes Birth Defects Foundation. Second edition. A Guide to Human Chromosome Defects. White Plains, NY: Medical Education Division, 1980.

5. March of Dimes Birth Defects Foundation. Genetic Counselling. White Plains, NY: Medical Education Division, pamphlet.

6. "Genetic Engineering Part I," American Biology Teacher, vol. 46, no. 7 (October 1984).

7. "Genetic Engineering Part II," American Biology Teacher, vol. 46, no. 8 (November/December 1984).

Available from Curriculum Development and Implementation Branch:

8. March of Dimes Birth Defects Foundation. Birth Defects: Tragedy and Hope. White Plains, NY: Medical Education Division, pamphlet.

Public Health Information Sheets:

. Tay-Sachs
. Spina Bifida
. Rubella
. Rh Disease
. Down's Syndrome
. Cleft Lip and Palate
. Clubfoot
. Sickle-Cell Anemia

AUDIO-VISUAL REFERENCES:

1. Film: "The Chromosomes of Man," EBE Biology Program, Visual Education Centre.

2. Film: "Biography of the Unborn," EBE Biology Program, Visual Education Centre.

Available from Manitoba Education Library:

3. Sound-Slide Program: "The Ethics of Genetic Control," The Center for Humanities, Inc. Science and Society: Ethical Issues Series.

4. Sound-Slide Program: "The New Genetics: Rights and Responsibilities," The Center for Humanities, Inc., Science and Society: Ethical Issues Series.

5. Sound-Slide Program: "The Ethical Challenge: Four Biomedical Case Studies," The Center for Humanities, Inc., Science and Society: Ethical Issues Series.

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
The student should be able to:		
1.0 Define "inborn error of metabolism."	Investigate the work of Garrod, Beadle and Tatum.	Addison-Wesley Biology: Chapter 20, "Heredity: Chromosomes and Genes." Biology and Human Concerns: Chapter 23, "Inborn Errors of Metabolism."
1.1 Explain how mutations affect the genetic code and lead to the synthesis of defective enzymes and other proteins.	Identify diseases resulting from faulty enzyme or other proteins, e.g., sickle-cell anemia, galactosemia, phenylketonuria, alkaptonuria, Tay-Sachs disease. Investigate the effect of single base pair changes on the amino acid sequence of hemoglobin.	Biological Science: A Molecular Approach: Chapter 10, "The Genetic Code." Biology and Human Concerns: Chapter 17, "Chemical Basis of Inheritance"; Chapter 21, "Human Hemoglobins and Gene Action"; Chapter 23, "Inborn Errors of Metabolism." Biological Science: A Molecular Approach: Chapter 10, "The Genetic Code."

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
		Biology: The Science of Life: Chapter 44, "Genetic Change and Evolution."
1.2 Give examples of the ways genetic diseases can be detected.	Discuss the various techniques used to detect genetic diseases pre- and post-natally, e.g., amniocentesis, fetoscopy, ultrasound, chorionic villus biopsy, cell culture, biochemical tests on blood, urine and other body products.	Biology and Human Concerns: Chapter 23, "Inborn Errors of Metabolism."
2.0 Relate how deviations from the normal number and pattern of human chromosomes give rise to genetic abnormalities.	Make karyotypes of normal and abnormal human chromosome complements.	Biology and Human Concerns Laboratory Manual: Chapter 16. Biology and Human Concerns: Chapter 25, "Human Chromosomes and Autosomal Abnormalities"; Chapter 26, "Sex Chromosome Abnormalities."
2.1 Recognize the causes of chromosomal anomalies, e.g., non-disjunction, translocation, inversion, deletion and duplication.	Examine karyotypes of Down's syndrome, Cri-du-chat, Turner syndrome, Klinefelter syndrome, XYY.	Biology and Human Concerns Laboratory Manual: Chapter 16.
3.0 Differentiate between genetic and non-genetic fetal abnormalities.	Discuss the effects of infections, drugs, medication, alcohol, smoking, nutrition and x-rays on fetal development. Discuss the effects of education and public health programs in reducing the incidence of non-genetic defects.	

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
3.1 List various corrective and preventive measures which can reduce the incidence of genetic diseases.	Discuss genetic counselling, prenatal care, dietary regulation, hormone therapy, corrective surgery, prosthesis and rehabilitative training.	Biology and Human Concerns: Chapters 20-28.
3.2 Identify ethical and social issues involved in screening for genetic diseases.	Apply the decision making model outlined on pages 59-64 of this guide to such questions as: identification and compulsory sterilization of individuals with undesirable genotypes, selective breeding of individuals with desirable genotypes, choice of the sex of a child, termination of pregnancy when the fetus is known to be genetically defective, the financial and social costs of maintaining individuals suffering from genetic defects. Other issues of local or contemporary interest can be covered as appropriate.	Biology and Human Concerns: Chapters 32-34. Biomedical Technology

OPTION H: TITLE: Project or Research TIME: 10-15 hours

RATIONALE: This unit strives to develop in students an understanding of the need for using a critical, quantitative approach when looking at data. An understanding of and appreciation for both the limitations and uncertainties involved in interpreting biological data can be supported, as this unit directs, by helping students identify a problem for study, to gather and analyze data, and to evaluate information in a critical and objective manner. Since it may be necessary to use a variety of reference materials containing different ideas and approaches, all materials listed in this unit are suggested as single copy references.

SECONDARY REFERENCES:

1. Biological Science Curriculum Study. Biological Science: Interaction of Experiments and Ideas. New Jersey: Prentice-Hall Inc., 1977.

2. Paetkaw, Paul. Projects Sourcebook for Life Science. Canada: Doubleday Canada Ltd., 1975.

3. Kimball, John W. Man and Nature: Principles of Human and Environmental Biology. Menlo Park: CA: Addison-Wesley Publishing Co., Inc., 1975.

4. Province of Manitoba. Safety in Science. Winnipeg: Province of Manitoba, 1982.

5. Morholt, E., et al. A Sourcebook for the Biological Sciences. Toronto: Harcourt Brace World, 1966.

6. Alternatives: Perspective on Society and the Environment. Peterborough, ON: Trent University (periodical).

OBJECTIVES	SUGGESTED ACTIVITIES	REFERENCES
The student should be able to:		
1.0 State a hypothesis relating energy produced to food available, e.g., food concentration related to carbon dioxide production in yeast. 1.1 Use science processes of observation and interpretation of data to test a hypothesis. 1.2 Review the hypothesis in terms of the observed data and accept, reject or modify the data for additional testing.	Discuss potential relationships between energy production and availability of food. Emphasis should be upon determining variables which can serve as indicators of this relationship. Once a variable has been identified and examined, the validity of data and potential need for additional variables should be determined. Students should become aware that a number of variables and tests may be needed to eliminate some uncertainty.	Biological Science: Interaction of Experiments and Ideas: "Hypotheses and the Design of Experiments"; and "Problems in the Control of Variables." Projects Sourcebook for Life Science: "Projects Using Planarians." NOTE: The objectives and activities suggested are a sample scheme only.
2.0 Specify some principles of experimental design in relation to the design attempted in 1.0-1.2. 2.1 State potential variables that could affect the problem and state potential alternative hypotheses and investigations that could be tested.	Determine, by discussion, additional potential tests and investigate a hypothesis which is related to the previous hypothesis but which still examines the general relationship between energy and food availability.	Biological Science: Interaction of Experiments and Ideas

appendices

APPENDIX A: ANNOTATED BIBLIOGRAPHY

CORE

1. Rahn, Joan E. Biology: The Science of Life. Second edition. New York: Macmillan Publishing Co., Inc., 1980.

   This text adequately covers the core topics in Biology 200 and 300 in depth except for diversity. Some supplementation of the diversity unit will be required. Depth of coverage is approximately college level; however, principles are presented in a logical manner beginning with fundamental concepts. The text also supports some options such as basic ecology, population ecology, support and movement, and evolution. The reading level is satisfactory for average high school students. No teacher's guide is available.

2. Kormondy, Edward J. and Bernice E. Essenfeld. Addison-Wesley Biology. Don Mills, ON: Addison-Wesley Publishing Co., 1984.

   This text uses a systems approach to developing the topics. Coverage of the topics is adequate except for the area of diversity of plants. However, areas which are weak are supplemented by diagrams and information in the teachers' resource book. This is a high school text and the reading level is satisfactory for the average high school student. A teacher's resource book, which contains additional diagrams and content in the areas of human physiology and diversity, is available. In addition, the resource book contains essays, sections on laboratory and study skills, and additional questions. Teacher's editions for the text and laboratory guides are available.

3. Berry, Gordon S., et al. Biology of Ourselves: A Study of Human Biology. Toronto: John Wiley and Sons, 1982.

   This text adequately covers the core in Biology 200 and some topics in Biology 300. In addition, options such as heart health and support and movement are developed. The content includes many applications which illustrate ways whereby human systems can be maintained. Experiments, demonstrations and exercises are included in the text. The reading level is adequate for the average high school student. A teacher's guide is available.

4. Volpe, Peter E. Biology and Human Concerns. Third edition. Dubuque, IO: Wm. C. Brown Co., 1983.

   This text is intended for use as a teacher's reference only. It is very useful in extending many of the topics such as cellular biology, human genetics and systems, origin and evolution, and environment and behaviour. In addition to basic information, ethical probes are provided which can be used to stimulate the examination of a variety of biologically related questions.

5. Kaskel, Albert, et al. Laboratory Biology: Investigating Living Systems (Canadian SI edition). Columbus, OH: Charles E. Merrill Publishing Co., 1983.

   This laboratory guide provides a large number of laboratory activities which support the Biology 200-300 program. The laboratory activities are designed to support students working on their own by providing questions in addition to procedures. The laboratory activities tend to develop concepts rather than emphasize a more open inquiry approach. The laboratory activities attempt to use relatively inexepensive materials. The reading level is about grade nine to ten. A teacher's guide, which includes some additional activities, is available.

6. Zahbrobsky, George. Addison-Wesley Biology: Laboratory Manual. Don Mills, ON: Addison-Wesley Publishing Co., 1984.

   This laboratory manual provides a variety of laboratory activities which support the Biology 200-300 program. However, the number of laboratory activities available in the area of human biology is limited. The laboratory manual uses procedures, questions, diagrams and charts to help the student to develop concepts. The laboratory activities attempt to use inexpensive materials. A teacher's guide is available.

OPTIONS

1. The Wild Cells: A Biology Manual. Winnipeg: The Canadian Cancer Society, 1981.

   This manual is a guide to the biology of cancer. Topics which are developed include the nature and types of cancer and recent advances in research. Support materials include the manual, a set of 35 mm slides, and A Source Book for Teachers and Students.

2. Saskatchewan Department of the Environment. Wetlands Management Case Study. Saskatoon: Western Extension College Educational Publishers, 1978.

   This case study kit includes a student's case book, data bank, wall map, film strip and teacher's guide. The case study approach provides data and directions which will help students to examine and balance potential uses for wetlands. A number of teaching approaches such as simulation, directed inquiry or lecture can be used.

3. The Garrison Diversion: An Environmental Issue. Winnipeg: Department of Natural Resources, 1981.

   This is a kit which includes overhead transparencies, simulations, a survey instrument, bibliography and tests.

4. Lewis, John (project director). Science in Society: Teacher's Guide. Agincourt, ON: Irwin Publishers, 1981.

These materials were designed to make students aware of the implications of science and technology for society. The teacher's guide provides information about a variety of topics and describes methodology which can be used. The topics which are outlined in the guide, and supported by student modules, can be used in the new physics and chemistry programs in addition to the biology program. A number of references are British and will have to be changed to adapt to the Canadian situation.

_____. Science in Society: Diseases and the Doctor - Book A; Population and Health - Book B; Medicine and Care - Book C.

These three modules can be used to support various parts of the unit, Medical Care and Health. Limited numbers of copies can be used as readers to develop either the total unit or a part of the unit.

_____. Science in Society: Dental Health Project; Science in Society; Marimbian Health Project.

These are packages which include a teacher's guide and student materials. The projects are simulations which examine some specific health oriented questions. The Dental Health Project examines the question of fluoridation and the Marimbian Health Project examines the needs and resources required to provide an effective health service.

5. BSCS. Human Genetics. Dubuque, IO: Kendall/Hunt Publishing Co., 1983.

This material uses genetic content to explore a wide variety of issues. Topics which are examined include genetic screening, mutations, amniocentesis, and molecular biology in industry. Instructional strategies are suggested for each topic. Student materials and a teacher's guide are available.

6. BSCS. Science, Technology, and Society. Dubuque, IO: Kendall/Hunt Publishing Co., 1984.

These materials introduce students to some general concepts about the nature and relationships among science, technology and society. An approach to decision making and technology assessment is developed. Modification of some of the issues may be necessary because of the rise of American examples and laws. Student materials and a teacher's guide are available.

BSCS. Biomedical Technology; Human Reproduction: Social and Technological Aspects. Dubuque, IO: Kendall/Hunt Publishing Co., 1984.

These titles include both student and teacher guides. The model developed in Science, Technology, and Society is applied to varying degrees; however, a number of ways to analyze issues are provided. Biomedical Technology includes the topics of genetic screening, in vitro fertilization, prenatal diagnosis, and recombinant DNA. Human Reproduction: Social and Technological Aspects includes the topics of pregnancy, prenatal diagnosis, adoption and population control.

7. Meeks, Linda B., and Phillip Heit. Health Focus on You: Venereal Diseases - Sexually Transmitted Diseases. Toronto: Charles E. Merrill Publishing Co., 1982.

   Information about causes, symptoms and treatment of various diseases. The book was developed for junior high school. Limited numbers would be useful.

8. Cherniak, Donna, and Allen Feingold. VD Handbook. Montreal: Montreal Health Press, P.O. Box 100, Station G, 1977.

   This publication provides detailed information about the nature, incidence, tests and treatment of various diseases. The source is paperback and would be useful as a teacher reference.

9. Meeks, Linda B., and Phillip Heit. Health Focus on You: Aging, Dying and Death. Toronto: Charles E. Merrill Publishing Co., 1982.

   Information is provided about signs of aging, adjustment to death, and customs and issues related to death. The book was developed for junior high school. Limited numbers would be useful.

10. Wrightman, Lawrence S., et al. Psychology: A Scientific Study of Human Behaviour. Belmont, CA: Wadsworth Publishing Company Inc., 1979.

    A wide variety of topics, such as development over the life span, sensation and perception, learning and memory, communication and thought, motivation, and social psychology, are examined. This book is a teacher reference.

11. BSCS. Biological Science: Interaction of Experiments and Ideas. Scarborough, ON: Prentice-Hall Inc., 1971.

    This text provides a wide variety of activities, ideas and potential research projects. Experimental approaches are outlined in the text.

12. Smith, Alice L. Microbiology and Pathology. Fourth edition. Toronto: C.V. Mosby, 1980.

    This is a college-level text which provides information on microbiology. The text is accompanied by a laboratory manual and workbook. Teachers must be prepared to use special caution in many of the laboratory activities.

APPENDIX B: SCIENCE PROCESS SKILLS

One important goal of science instruction in Manitoba is to encourage students to become increasingly active investigators of science. Instruction in the processes of science begins in the elementary grades and continues through high school. Below is a list, with definitions, of the process skills that the program aims to develop in students.

Observing: using the senses and mechanisms for extending these senses in the collection of data from physical phenomena. In high school, there is an emphasis upon systematic, quantitative observations; precision, accuracy and limitations of observations should occur.

Quantifying: using numbers and measuring length, weight, area, volume, concentrations and rate of change in physical phenomena. The selection of appropriate instruments, understanding of reliability and validity of measured data is emphasized in high school.

Formulating Hypotheses: making or evaluating an hypothesis (if/then statement) regarding the causes of a phenomenon or the relationship between two variables.

Making Operational Definitions: stating the operation to be performed and the observations to be made in applying a definition to an experiment.

Controlling and Manipulating Variables: making decisions concerning the control and manipulation of objects or conditions in an experiment and arranging conditions.

Interpreting Data: getting the most out of data without oversimplifying, making judgements about validity of explorations and suitability of an original hypothesis and assumptions, drawing conclusions supported by the data, and considering alternative explanations on the basis of supplied or observed data.

Classifying: grouping articles, objects and ideas on the basis of some observable biological, physical and chemical attributes.

Formulating Models: building both physical and mental models to account for phenomena. Alternative models can be presented and the merits and/or weaknesses of alternative models can be judged.

Communicating: describing an experiment so that an individual who has not seen it can carry it out. The emphasis is upon treating data in a more rigorous mathematical way, e.g., slopes of graphs, probability.

Inferring: drawing more than one inference or conclusion from a set of data, demonstrating that an influence can be tested by applying known tests to the properties of objects, and distinguishing between observations and inferences.

Predicting: conducting experiments to test predictions of relationshipsbetween two measurable quantities. Predictions can be defended in terms of logical arguments, careful observation and precise measurement.

Experimenting: planning and evaluating experimental designs, conducting and communicating an experiment in which the problem is clarified, hypotheses are stated, observations are made and data is interpreted.

DISCUSSION SKILLS

. To be able to discuss a topic, a student should be able to:

1. Produce an oral or written statement about the topic that is:

   a) logical
   b) coherent
   c) supported by facts

2. Present, if appropriate, various points of view about the topic.

3. Understand the information heard or read; and evaluate the accuracy and logic of the information heard or read.

4. Explain the implications of the topic.

. A student should be able to use the following process skills:

1. Science process skills
   - gather and interpret data from direct observation
   - computational skills
   - psychomotor skills associated with science process skills
   - other science processes (integrated)

2. Investigative skills
   - identifying potential sources of information such as libraries, resource people and computerized data bases
   - using appropriate library facilities to identify potential sources of information
   - using indexes to periodical literature to identify relevant periodical literature
   - interpreting and evaluating published information relating to biology
   - summarizing, evaluating, and integrating information acquired from a variety of sources
   - communicating effectively in both written and oral form about biologically related subjects